OUR FOOD

SWAMINATHAN

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With A Foreword

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FOREWORD

DURING the long span of human society, considerable amount of experience has been built up not only about articles that are useful as human food, but also the various methods of using them. Such experience, though useful, has remained largely empirical and until the present century, very little was done to find the correct explanation for the various practices and to improve on them. During the last 50 years, a great deal of new knowledge regarding food and nutrition and nutritional requirements of human beings has accumulated.

In our attempt at utilising the new knowledge for improving the existing dietary pattern, it should be our major aim to assist ourselves and those around us to produce as complete and balanced diets as possible out of those foodstuffs which are easily available to us. In doing so, we should try to fit them into the pattern of dietary to which we have long got accustomed. If the consumers know about the benefits of balanced diets, they will gradually take to them—though the changes may not be too rapid.

During recent years, there have been useful attempts to evolve diet charts to suit different economic levels, but these have not found much application because the average consumer has not found it possible to fit them into the routine. Moreover, one may not always have the capacity to utilise certain forms of foods, however good they may otherwise be. In order to meet this difficulty and, at the same time, to avoid drastic changes in dietary pattern, the best course would be to find a selection of concentrated foods that can be consumed in small quantities and which would meet a substantial part of the deficiencies in our

diets. Such incorporation would be cheap and, at the same time, contribute materially to the improvement of our health.

The greatest difficulty experienced by the food scientist is in respect of new foods. In other countries, the industry makes specialities of such foods and advertises them in the widest manner possible so that the consumer is actually induced to buy them. Under our conditions, the progress is more difficult chiefly because of the lack of big enterprises in the field. In India, the food industries have been in the hands of large numbers of small producers of one kind or another who have long been content with traditional practices and the small returns obtained from them. This situation places an extra responsibility on the scientist who has also to carry the idea to the people and to popularise the new products.

In the present contribution, the authors, who are also active workers in the field, have presented, in simple language, the recent advances in the field of food and nutrition and also some of their practical applications. The publication will serve not only as a manual of reference but also as a general guide for application. It deserves a place in every home and, while wishing the effort every success, I do hope that it will lead to further and bigger efforts that will be of increasing measure of benefit to the public.

Mysore
February 1959

V. SUBRAHMANYAN
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PREFACE

FOOD is the prime necessity of life. The newer knowledge of food and nutrition gained during the last 50 years has shown that a nutritionally adequate diet is essential for maintaining the body in good health and for increasing the physical efficiency of human beings. Progress in nutrition research has been very rapid and spectacular. The need for applying the available knowledge for improving the diet and health of the people has been keenly felt by International organisations like FAO, WHO and UNICEF and also by various Governments. Dietary and nutrition surveys carried out during the past decade in different parts of India have shown that the diets of the vulnerable groups of the population i.e. children and expectant and nursing mothers, are deficient in protein, calcium, vitamin A and some vitamins of the B-group. Diseases due to the deficiency of vitamins and protein are widely prevalent among children and expectant and nursing mothers belonging to the low income groups of the population. The diets are lacking in protective and protein-rich foods such as milk, eggs, meat and fish. It is also generally recognised that the present production of milk, eggs, meat and fish is highly inadequate to meet the requirements of the entire population. There has also been a shortage in the supply of cereals in the country. Further, the vast majority of the people are not aware of the types of foodstuffs required to meet the dietary requirements for the different age groups. The aim in writing this book has been three-fold: (1) to provide in brief the newer knowledge of food and nutrition for the use of home science students, public health and social service workers, school teachers and others interested in

food and nutrition ; (2) to make the information available to a large group of persons by presenting it in non-technical language and (3) *to point out how the newer knowledge of nutrition can be utilised for the better feeding of the people using the available food resources.*

In this book, special emphasis has been placed on (1) the preparation and use of milk substitutes of vegetable origin and other types of low cost protein-rich foods as a supplement to the diet of the people who cannot afford to buy costly foods like milk, eggs etc., and (2) the utilisation of subsidiary foods like roots and tubers as partial substitutes for cereals in overcoming the cereal shortage.

The problem of improving the diets of the low income groups of the population is beset with several difficulties. This can be achieved only by a concerted effort on the part of the people and the Government. It is the hope of the authors that this book may prove useful to all concerned in spreading the knowledge of nutrition among the people and thus help to improve the health of the common man.

We are highly thankful to Dr. V. Subrahmanyan, Director, Central Food Technological Research Institute, Mysore, for his kind interest in our effort and for writing the foreword to the book. The authors will be glad to receive suggestions for enhancing the usefulness of the book.

We are specially thankful to Sri S. Kuppuswamy and Dr. R. Rajagopalan of our Institute for going through the manuscript and offering valuable suggestions and to Sri S. Subbaiya of Ganesh and Co. (Madras) Private Ltd., the well known educational publisher of Madras, and to the Manager, Wesley Press, Mysore, for their help in bringing out this book within a short time.

Mysore
February 1959

M. SWAMINATHAN
R. K. BHAGAVAN

CONTENTS

I. FUNCTIONS OF FOOD

The food we eat everyday contains the following dietary essentials: (*i*) Proteins (*ii*) Fats (*iii*) Carbohydrates (*iv*) Mineral salts and (*v*) Vitamins. Food nourishes the body in the following ways: (1) It provides the body with fuel, such as *fats* and *carbohydrates*, which are oxidised in the body to supply the *energy* required for various activities. (2) It provides *proteins* for the *building* and *upkeep* of the body tissues. (3) It furnishes *vitamins* and *minerals* by means of which the life processes in the body are regulated, thereby protecting the body against *ill health.*

Functionally foods are classified as follows:

(*i*) *Energy yielding foods:* Foods rich in carbohydrates and fats are called energy yielding foods. Cereals, roots and tubers, dried fruits, sugars and fats are included in this group. Cereals contain, in addition, fair amounts of protein, minerals and certain vitamins and form the important sources of the above nutrients in poor dietaries.

(*ii*) *Body building foods:* Foods rich in proteins are called body building foods. Milk, meat, fish, eggs, pulses, oilseeds and nuts and low-fat oil-seed flours are included in the group of body building foods.

(*iii*) *Protective foods:* Foods rich in *proteins*, *vitamins* and *minerals* are termed protective foods. Milk, eggs, liver, green leafy vegetables and fruits are included in this group of protective foods. Protective foods are broadly classified into two groups: (*a*) Foods rich in *vitamins*, *minerals* and *proteins* of high biological value *e.g.* milk, eggs,

meat, fish and liver. (*b*) Foods rich in certain *vitamins* and *minerals* only *e.g.* green leafy vegetables and fruits.

II. CALORIFIC VALUE OF FOODSTUFFS

The importance of calories

The quantitative requirement of food for the human body is expressed in terms of a unit called the large 'CALORIE'. It is a unit of heat, used as a yard-stick for measuring the energy derived from foods by the body. The *calorific value* of a food depends on the quantity of carbohydrates, fats and proteins present in them:

1 gram of *carbohydrate*	yields	4	*calories*
1 gram of *fat*	,,	9	,,
1 gram of *protein*	,,	4	,,

Calorific value of foodstuffs

Cereals, pulses, nuts, oils and fats and sugar form the important sources of calories in the diets of adults and older children. In the case of infants and young children below 2 years of age, milk is an important source of calories besides proteins, vitamins and minerals. The calorific value of certain important foods is given in Table 1.

Table 1. **Calorific value of some foodstuffs**

	Calories (Per 100g.)		*Calories (Per 100g.)*
Oils and Fats:		Gingelly seeds	... 564
Vegetable oils and ghee	900	Groundnut	... 549
Butter	... 731	Walnut	... 687
Nuts and oilseeds		*Sugar, Jaggery and dried fruits*	
Almond	... 655	Cane sugar	... 400
Cashewnut	... 596	Jaggery	... 383
Cocoanut, fresh	... 444	Raisins, dry	... 319
Cocoanut, dry	... 735	Dates, dry	... 283

	Calories (Per 100g.)
Cereals	
Bajra	360
Cholam	341
Maize (dry)	342
Oatmeal	374
Ragi	332
Wheat	348
Rice, raw milled	348
Pulses	
Bengal gram	361
Black gram	350
Green gram	350
Horse gram	322
Lentil	346
Peas, dry	350
Red gram	345
Soya bean	432
Milk and Milk products	
Milk (Buffalo's)	117
Milk (Cow's)	65
Milk (Skimmed, reconstituted)	36
Milk powder, whole	496
Milk powder, skimmed	357
Flesh Foods	
Egg, hen's	173
Fish	100
Mutton	194
Liver	150

Energy requirements

The energy requirements depend on (1) Age (2) Height (3) Weight (4) Sex (5) Physical activity etc. The energy requirements of different individuals are given in Table 24.

III. PROTEINS

Proteins are the main constituents of the cells of the body and form the greater part of muscle and other tissues.

Functions of proteins

Proteins have the following important functions: (1) Promotion of growth (2) Repair of wear and tear of tissues (3) Production of metabolic and digestive enzymes and blood proteins (4) Production of hormones (5) Production of antibodies *i.e.* building up the body defences against infections.

Nutritive value of proteins

Proteins are composed of simpler substances known as *amino acids.* Proteins differ from one another in their

amino acid composition. Out of 22 *amino acids* commonly occurring in proteins, 10 are *essential* in the sense that they are necessary for the growth of animals and must be present in food proteins. *The nutritive value of a protein depends on its amino acid make-up.* Proteins may be broadly classified nutritionally into three groups:

(1) *Complete proteins:* Proteins which contain all the essential amino acids in adequate amounts and which can support good growth in young experimental animals *e.g.* proteins of milk, eggs, meat, fish, liver etc.

(2) *Partially complete proteins:* Proteins which are partially lacking in one or more essential amino acids and which will promote only moderate growth in young rats but can maintain nitrogen equilibrium in adults are called partially complete proteins *e.g.* proteins of cereals, pulses, nuts and oilseeds.

(3) *Incomplete proteins:* Proteins which are completely lacking in one or more essential amino acids and which do not promote any growth in young animals or even maintain nitrogen equilibrium in adult animals are called incomplete proteins *e.g.* gelatin.

Supplementary value between proteins

It is also important to note that proteins from two or more sources can make up each other's amino acid deficiencies, so that by a judicious combination of proteins from different sources, it is possible to meet the protein requirements. For example, proteins of pulses, nuts and oilseeds supplement those of cereals. All animal proteins supplement cereal proteins to a marked extent.

Effects of protein deficiency

Deficiency of protein manifests itself in different ways in the infant and adult. The infant loses weight, shows

stunted growth and may succumb to infections. After weaning, prolonged deficiency of proteins may cause a condition known as 'Kwashiorkor' which is characterised by (1) Impairment of growth (2) Irritability (3) Oedema which may involve the whole body (4) Dry, lustreless, discoloured hair (5) Dry, lustreless skin which may show cracking and pigmentation (6) Diarrhoea (7) Anaemia (8) Reduced resistance to infections (9) Enlarged liver which may develop into a condition known as cirrhosis resulting in the death of the child.

In the adults, deficiency of protein in the diet causes (1) Loss of weight (2) Anaemia (3) Reduced resistance to infections (4) Oedema of the feet and accumulation of free fluid in the abdomen (Ascites).

Protein requirements

The protein in the diet should be derived from different sources such as cereals, pulses, nuts and oil-seeds, milk and flesh foods. Since animal proteins possess, in general, a higher nutritive value than vegetable proteins, the diet of children and expectant and nursing mothers should, in particular, contain large amounts of proteins derived from milk, eggs and flesh foods. The protein requirements depend on (1) *age* and (2) *physiological state*. The daily protein requirements of different age groups are given in Table 24.

Table 2. **Important sources of proteins**

	Protein (*g*/*100g*.)		*Protein* (*g*/*100g*.)
Cereals		Ragi ...	7·1
Bajra (Cambu) ...	11·6	Rice, raw, home-pounded	7·5
Barley ...	11·5	Rice, raw, milled ...	7·0
Cholam (Jowar) ...	10·4	Samai ...	7·7
Italian millet ...	12·3	Wheat, whole ...	11·8
Maize (Corn) ...	11·1	Refined wheat flour (maida) ...	10·2
Oatmeal ...	13·6		

	Protein (g/100g.)
Nuts and Oilseeds	
Almond	20·8
Cashewnut	21·2
Cocoanut, fresh	4·5
Gingelly seeds	18·3
Groundnut	26·7
Pistachionut	19·8
Walnut	15·6
Flesh foods	
Egg, hen's	13·3
Egg white	13·3
Egg yolk	13·7
Fish	21·5
Mutton	18·5
Liver	19·3
Pulses	
Bengal gram dhal	22·5
Bengal gram	17·1
Black gram dhal	24·0
Cow gram	24·6
Field bean, dry	24·9
Green gram dhal	24·0
Horse gram	22·0
Lathyrus pea dhal	28·2
Lentil (Masur dhal)	25·1
Peas, dried	19·7
Red gram dhal	22·3
Soya bean	43·2
Milk and Milk products	
Milk, cow's	3·5
Milk, buffalo's	4·3
Milk, goat's	3·7
Milk, human	1·0
Milk powder, skimmed	38·0
Milk powder, whole	25·2

Note: 1. Important sources of protein in the diet of children are milk, pulses, nuts, animal foods and cereals.

2. Important sources of protein in the diet of adults are cereals, pulses, nuts and oilseeds.

3. Vegetables and fruits are poor sources of protein.

IV. CARBOHYDRATES

Carbohydrates serve as the main source of energy to the body. When consumed in excess, they may be converted into fat and stored in the body. Carbohydrate deficiency in the diet is not likely to occur except in times of food shortage. Cereals, roots and tubers, which are rich in carbohydrates, are the cheapest of foods. The carbohydrates present in foodstuffs include starch and the various sugars.

Disorders of carbohydrate metabolism

Carbohydrate utilisation is affected in the disease called *diabetes mellitus*. In this condition, the body is not able to

ıtilise the carbohydrates in sufficient amounts. There is excess of glucose in the blood and some of the glucose is excreted in the urine. Diets low in carbohydrates are usually prescribed for patients suffering from *diabetes mellitus*.

Carbohydrate requirements

The carbohydrates supply about 50–80% of the calories in the diet, depending on the economic status and age of the individual. In balanced diets, about 50-60% of the energy in the diet is supplied by carbohydrates.

Important sources of carbohydrates

Cereals are the most important sources of carbohydrates. Roots and tubers are next in importance. Pulses and fruits are moderate sources of carbohydrates. Certain amount of carbohydrate is also being consumed in the form of pure sugar or jaggery.

Fibre (cellulose and hemicellulose)

Fibre or roughage consists of cellulose and hemicellulose. These carbohydrates are not digested by the digestive juices. They are left unchanged after digestion.

Functions of fibre

Though contributing little to the nutritive value of the food, the presence of fibre in the diet is helpful in the evacuation of the bowels. It prevents the tendency to constipation.

Fibre content of foods

Whole cereals and vegetables are fair sources of fibre. The fibre content of foods is given in Table 36.

Table 3. **Important sources of carbohydrates**

	Carbohydrate (g/100g.)
Pure carbohydrate foods	
Sugar	99.8
Jaggery	95.0
Honey	79.5
Sago	87.2
Arrowroot flour	83.1
Cereals	
Bajra (Cambu)	67.1
Barley	69.3
Cholam (Jowar)	70.3
Maize (Corn)	66.2
Oatmeal	62.8
Ragi	73.0
Rice, raw, home-pounded	76.2
Rice, raw, milled	79.3
Rice, parboiled, milled	77.7
Wheat, whole	71.2
Wheat flour (maida)	74.1
Pulses	
Bengal gram dhal	58.9
Black gram dhal	60.3
Cow gram	55.7
Field bean	60.1
Green gram	60.7
Masur dhal	59.7
Red gram dhal	60.2
Roots and Tubers	
Potato	22.9
Sweet potato	31.0
Tapioca, fresh	38.7
Tapioca flour	85.5
Fruits	
Dates, dried	67.3
Raisins, dried	77.3
Prunes, dried	71.0
Figs, dried	68.0
Fresh fruits	15-25

V. FATS

Functions

Fats serve as a source of energy along with carbohydrates and are also stored in the body beneath the skin (subcutaneous fat or depot fat) and to some extent in other parts of the body. Fat in the diet serves as a carrier for the fat soluble vitamins (A, D, E and K). Fat also supplies the essential fatty acids which are needed by the body.

Effects of deficiency

No specific effects of fat deficiency are known in human beings. Even in the absence of fat in the diet, the carbohydrates and proteins are converted into fat to some extent in the body. But prolonged deficiency of fat in the diet may cause the following effects: (1) Dryness of

the skin (2) Secondary deficiency of the fat soluble vitamins (A, D, E and K) (3) Since the essential fatty acids are not being supplied, eczema-like skin conditions may develop in some individuals, particularly in children.

Effects of excess fat in the diet

Excessive consumption of fats may cause the following effects: (1) Obesity (2) Digestive disturbances, particularly in children (3) Animal fats contain cholesterol. When large amounts of animal fats are consumed, cholesterol may accumulate in the blood and may get deposited on the walls of the blood vessels, causing a disease known as *Atherosclerosis* and finally heart disease (4) Accumulation of excessive amounts of cholesterol in the gall bladder may cause stones in the gall bladder (5) In a diabetic patient, consumption of excess of fat may produce excessive amounts of acetone bodies which may lead to serious consequences like severe acidosis and coma, resulting even in death.

Table 4. **Important sources of fat**

	Fat (*g./100g.*)
Oils and Fats	
Ghee	100
Butter	81
Vegetable oils	
Groundnut, sesame, mustard and cocoanut oils	100
Vanaspati (Hydrogenated vegetable fat)	100
Nuts and Oilseeds	
Almond	58.9
Cashew nut	46.9
Cocoanut (fresh)	41.6
Cocoanut (dry)	65.0
Gingelly (sesame) seed	43.3
Groundnut	40.1
Nuts and Oilseeds (Cont)	
Pistachio nut	53.5
Walnut	64.5
Soya bean	19.5
Milk and Milk Products	
Cow's milk, whole	3.6
Buffalo milk, whole	8.8
Khoa (from whole cow's milk)	15.2
Khoa (from whole buffalo milk)	31.2
Whole milk powder	26.7
Flesh foods	
Egg, hen's	13.3
Mutton	13.3
Liver	7.5
Fish	1.5 to 10.2

VI. VITAMINS

Apart from proteins, carbohydrates, fats and minerals, there are certain other substances present in minute amounts in most foodstuffs and are necessary for growth and health. They are called vitamins. Several vitamins have been discovered so far but for humans the most important are the following:

(1) Vitamin A and Carotene
(2) ,, D
(3) ,, B_1 (Aneurin, Thiamine)
(4) Riboflavin
(5) Nicotinic acid
(6) Vitamin C (Ascorbic acid)
(7) Vitamin B_{12}
(8) Folic acid
(9) Pyridoxine and
(10) Pantothenic acid.

VITAMIN A AND CAROTENE

Vitamin A is present only in foods of animal origin, while plant foods contain certain pigments called carotenes (carotenoids) which are converted into vitamin A in the body.

Functions

Vitamin A is essential for the integrity of epithelial tissues and is a stimulus for new cell growth. It also helps to maintain resistance to infections. It is necessary for maintaining the eye in healthy condition and for proper vision in dim light.

Effects of deficiency

A continued deficiency of this vitamin in the diet causes the following disorders:

(1) *Phrynoderma* or toad skin (2) *Night blindness* (3) *Xerophthalmia* (dryness of the conjunctiva of the eyes) (4) *Bitot's spots* (greyish patches on the white of the eye) (5) *Keratomalacia* (ground glass appearance of the eye) (6) Defective teeth (lack of enamel) (7) Reduced resistance to infections (8) Tendency to the formation of kidney stones.

Daily requirements of Vitamin A

The daily requirements of vitamin A for the different age groups are given in Table 24.

Vitamin A content of foods

The vitamin A activity of foods, expressed in International units (I.U.), is given in Table 5.

Table 5. **Vitamin A and Carotene—Important sources**

1. Foods containing carotene

	Vitamin A value (I.U. per 100g.)
Red palm oil	40,000–50,000
Green leafy vegetables	
Amaranth leaves	2,500–11,000
Cabbage	2,000
Coriander leaves	10,460–12,600
Curry leaves	12,600
Drumstick leaves	11,300
Fenugreek leaves	3,900
Radish leaves	6,700
Mint	2,700
Spinach	5,500
Other vegetables	
Carrot	2,000–4,300
Pumpkin, yellow	1,000
Fruits	
Jack fruit	540
Mango, ripe	4,800
Papaya, ripe	2,020
Orange	350
Tomato, ripe	320

2. Foods containing vitamin A

Fish liver oils	(*I.U. per gram*)	(*I.U. per teaspoon*)
Halibut liver oil	20,000	60,000
Shark liver oil	3,000–20,000	9,000–60,000
Cod liver oil	2,000	6,000
Shark liver oil (Indian Pharmacopoeia)	2,000	6,000

Note: One teaspoonful of cod or shark liver oil will supply the daily requirements of vitamin A.

Other foods	(*I.U. per 100g.*)
Liver, goat or sheep	... 22,300
Egg, whole	... 2,200
Egg yolk	... 3,600
Butter	... 2,500
Ghee, fresh	... 2,000
Fatty fish	... 100
Milk, fresh whole (cow's or buffalo)	... 180
Milk, human	... 208
Milk powder, whole	... 1,400

VITAMIN D

Functions

Vitamin D increases the absorption of calcium and phosphorus and regulates their concentration in the blood. It directly helps in the formation of hard and healthy bones and teeth.

Effects of deficiency

Deficiency of vitamin D causes *rickets* in children and *osteomalacia* in adults.

Rickets is characterised by delayed and irregular dentition, stunted growth and soft and curved bones.

Osteomalacia is characterised by softened bones, curved spine and pelvic deformity. This occurs generally in women who observe purdah and remain indoors.

Daily requirements

The body obtains vitamin D from two sources: (1) food and (2) sun light. The requirement of vitamin D in temperate climate is 400 international units for adults and children. Since exposure to sun light produces

vitamin D in the body, persons living in tropical countries may derive considerable amount of vitamin D from this source and may need only about 200 units from food.

Vitamin D content of foods

Vitamin D occurs mainly in foods of animal origin and is present only in a few foods. The vitamin D content, expressed in International units (I.U.), is given in Table 6.

Table 6. **Important sources of vitamin D**

Fish liver oils	(*I.U. per g.*)	(*I.U. per teaspoonful.*)
Halibut liver oil	1,200	3,600
Cod liver oil	100	300
Shark liver oil	50-150	150–450
Other foods	(*I.U. per 100g.*)	
Butter	40	
Eggs	100	
Milk, fresh, whole	2	
Milk powder, whole	16	
Liver, goat or sheep	40	
Fatty fish	50–100	

Note: Vitamin D is not present in common foods of vegetable origin.

VITAMIN B_1 (THIAMINE, ANEURIN)

Functions

Vitamin B_1 plays an important part in carbohydrate metabolism. It is essential for the maintenance of good appetite and normal digestion. It is also required for the normal functioning of nerve tissues.

Effects of deficiency

A mild deficiency of this vitamin in the diet results in *anorexia* (loss of appetite), digestive disturbances and vague neuritic pains. A frank deficiency for a prolonged time causes a disease known as *beriberi*. *Beriberi* is of two types : (1) *Dry beriberi* and (2) *Wet beriberi*.

Dry beriberi is characterised by (1) Loss of appetite (2) Tingling and numbness of the legs and hands (3) Paralysis of the legs and hands (4) Drooping feet (5) A peculiar stamping gait.

Wet beriberi is characterised by (1) Oedema of legs and abdomen due to accumulation of fluid (2) Enlargement of the heart and signs of heart failure (3) Palpitation and breathlessness.

Daily requirements

The daily requirements of vitamin B_1 are given in Table 24.

Vitamin B_1 content of foods

The vitamin B_1 content of foods is given in Table 7.

Table 7. **Important sources of Vitamin B_1**

	Vitamin B_1 (mg/100g.)
Dried yeast	3–6
Rice polishings (from raw paddy)	2·1
Wheat germ	2·2
Cereals	
Wheat, whole	0·54
Bajra (Cambu)	0·33
Cholam (Jowar)	0·35
Ragi	0·42
Italian millet	0·59
Barley	0·45
Oats	0·54
Rice, raw, husked	0·40
Rice, raw, home-pounded or undermilled	0·22
Rice, raw, milled	0·11
Rice, parboiled, undermilled or home-pounded	0·32
Rice, parboiled, milled	0·22
Rice, beaten	0·21
Rice, puffed (from paddy)	0·22
Rice, puffed (from rice)	0·10
Pulses	
Bengal gram	0·45
Green gram	0·46
Black gram	0·45
Masur dhal	0·43
Red gram dhal	0·45
Field bean	0·52
Cow gram	0·50
Horse gram	0·42
Soya bean	0·73
Nuts and oilseeds	
Groundnut	0·90
Cashew nut	0·63
Gingelly (sesame) seeds	1·01
Almond	0·44
Cocoanut, fresh	0·05
Pistachio nut	0·67
Walnut	0·45
Other foods	
Milk, fresh	0·05
Egg, hen's	0·13
Mutton	0·18
Liver	0·36
Fish	0·10

Note: 1. Important sources of vitamin B_1 in the diet of adults are whole cereals, pulses, nuts and oilseeds.

2. Milk is an important source of vitamin B_1 in the diet of infants and young children.

RIBOFLAVIN

Functions

Riboflavin is concerned in the oxidation of carbohydrates, proteins and fats.

Effects of deficiency

(1) Burning sensation of the eyes, lips and tongue (2) Inflammation and vascularisation of the cornea of the eyes (3) Dimness of vision (4) Fissuring at the angles of the mouth (*Cheilosis* and *Angular stomatitis*) (5) Inflammation of the tongue (*Glossitis*) and (6) *Dermatitis* (naso labial folds, behind the ears, scrotal skin etc.)

Daily requirements

The daily requirements of riboflavin are given in Table 24.

Table 8. **Important sources of Riboflavin**

	Riboflavin (mg/100g.)		*Riboflavin (mg/100g.)*
Dried yeast	... 4·50	*Pulses*	
Liver, goat or sheep	... 3·20	Bengal gram	... 0·21
Milk powder, whole	... 1·36	Black gram	... 0·22
Milk powder, skimmed	1·64	Cow gram	... 0·21
Milk fresh, cow's or buffalo	... 0·20	Green gram	... 0·26
Egg, hen's	... 0·35	Lentil (Masur dhal)	... 0·23
Egg yolk	... 0·43	Red gram	... 0·22
Egg white	... 0·22	Soya bean	... 0·32
Green leafy vegetables	0·12–0·16	*Cereals*	
Amaranth	... 0·10	Whole cereals	0·10–0·16
Fenugreek leaves	... 0·16	Milled cereals	0·03–0·08
Spinach	... 0·11		

Note: 1. Important sources of riboflavin in the diet are milk, eggs, liver, green leafy vegetables and pulses.
2. Milled cereals are poor sources of riboflavin.

NICOTINIC ACID (NIACIN)

Functions

Nicotinic acid (Niacin) and Nicotinamide (Niacinamide) have the same vitamin activity. They take part in the metabolism of carbohydrates, fats and proteins.

Effects of deficiency

Severe nicotinic acid deficiency causes a disease known as *pellagra* characterised by the following symptoms: (1) Dark pigmentation and dermatitis of exposed parts of the body (2) Soreness of mouth and tongue (3) Diarrhoea (4) Mental disturbance (5) Anaemia.

Daily requirements

The daily requirements of nicotinic acid are given in Table 24.

Table 9. **Important sources of Nicotinic acid**

	Nicotinic acid (mg/100g.)
Dried yeast	27
Liver, goat	17.6
Groundnut	14.1
Groundnut flour	19.5
Mutton	6.8
Fish	3.0
Pulses	1.5 to 2.5
Cereals	
Wheat, whole	5.0
Rice, raw, husked	3.5
Rice, raw, undermilled (home-pounded)	2.2
Rice, raw, milled	1.0
Rice, parboiled and undermilled (home-pounded)	3.5
Rice, parboiled, milled	2.4
Bajra (Cambu)	2.3
Cholam (Jowar)	1.3
Maize (Corn)	1.2

Note: 1. Important sources of nicotinic acid in the diet are whole cereals, groundnut, liver and mutton.

2. Maize (Indian corn) is a poor source of nicotinic acid and diets based mainly on maize and containing little of other foods are likely to give rise to *pellagra*.

3. Vegetables, fruits, milk and eggs are poor sources of nicotinic acid.

4. The body is able to synthesise certain amount of nicotinic acid from the amino acid tryptophan present in proteins.

FOLIC ACID

Functions of Folic acid

Folic acid stimulates the formation of red blood cells in the bone marrow. It also stimulates the formation of white blood corpuscles.

Folic acid deficiency

The deficiency of folic acid in the diet results in the development of *macrocytic anaemia*. This disease commonly occurs in pregnant women subsisting on ill-balanced diets.

Daily requirements

The folic acid requirements are given below :

Requirements	*Folic acid (mg/day.)*
Children	... 0·2–0·5
Adults	
Man	... 0·5
Woman	... 0·6
Woman (pregnancy)	... 0·8
Woman (lactation)	... 0·8

Folic acid content of foods

The folic acid content of some important foods is given in Table 9 A.

Table 9 A. **Folic acid content of foods**

Cereals	*Folic acid (mg/100g.)*
Barley	... 0·05
Maize	... 0·03
Oats	... 0·03
Rice, raw, husked	... 0·04
Rice, raw, milled	... 0·02
Cholam	... 0·02
Wheat	... 0·04
Other whole cereals (unspecified)	... 0·02
Pulses	
Field bean	... 0·14
Soya bean	... 0·21
Peas, dried	... 0·12
Other pulses (unspecified)	... 0·12
Nuts and oilseeds	
Almond	... 0·05
Groundnut	... 0·05
Cocoanut, dry	... 0·03

	Folic acid (mg/100g.)
Vegetables	
Beans	... 0·03
Beet root	... 0·02
Cabbage	... 0·05
Carrot	... 0·01
Cucumber	... 0·15
Lettuce	... 0·04
Potato	... 0·01
Pumpkin	... 0·01
Sweet potato	... 0·01
Spinach	... 0·09
Tomato	... 0·01
Other green leafy vegetables (unspecified)	... 0·09
Milk and Milk products	
Milk, cow's	... 0·03
,, , buffalo	... 0·03
,, , human	... 0·02

Fruits	*Folic acid (mg/100g.)*	*Flesh foods*	*Folic acid (mg/100g.)*
Apple	... 0·01	Liver, ox	... 0·30
Banana	... 0·04	,, , lamb	... 0·28
Grape fruit	... 0·02	,, , pig	... 0·22
Grapes	... 0·03	Chicken	... 0·01
Lemon	... 0·09	Egg, hen's	... 0·01
Orange	... 0·04	Beef	... 0·01
Pears	... 0·02	Mutton, lamb	... 0·01

It is evident from Table 9A that whole cereals, pulses and green leafy vegetables are the most important sources of folic acid in the average Indian dietaries.

VITAMIN B_{12}

Vitamin B_{12} is identical with the antipernicious anaemia factor occurring in liver. It stimulates the formation of red blood cells.

Vitamin B_{12} deficiency

Severe vitamin B_{12} deficiency causes *macrocytic anaemia*. This disease commonly occurs in pregnant women subsisting on ill-balanced diets.

Requirements: The daily requirements of vitamin B_{12} range from 0.5 to 2 micrograms depending on age and physiological state and are given below:

	Vitamin B_{12} (microgram).
Children	... 0·5–1·0
Man	... 0·8
Woman	... 1·0
Woman (pregnancy)	... 2·0
Woman (lactation)	... 1·5

Vitamin B_{12} content of foods

Vitamin B_{12} is not present in foods of vegetable origin. It occurs only in foods of animal origin. The vitamin B_{12} content of some foods is given in Table 10.

Table 10. **Vitamin B_{12} content of foods**

	Vitamin B_{12} (*microgram/100g.*)		*Vitamin B_{12}* (*microgram/100g.*)
Liver, ox	... 118	Egg, duck's	... 8·6
,, , sheep	... 133	Milk, cow's	... 0·60
,, , goat	... 120	,, , buffalo	... 0·35
,, , pig	... 59	,, , human	... 0·02
Mutton, goat	... 10·5	,, , goat	... 0·09
,, , sheep	... 30·0	,, powder (skimmed)	3·0
Fish	... 23·0	,, powder (whole)	2·3
Egg, hen's	... 10.4		

VITAMIN C (ASCORBIC ACID)

Functions

Vitamin C is necessary for the formation and maintenance of the intercellular cement substances and for hastening the healing of wounds and of bone fractures. It is also probably necessary for the maturation of the red blood cells.

Effects of deficiency

Deficiency of vitamin C in the diet causes the disease known as *scurvy* which is characterised by the following symptoms: (1) Weakness and irritability (2) Bleeding into the skin and joints (3) Tender, swollen and bleeding gums (4) Failure of healing or delayed healing of wounds and of bone fractures (5) Anaemia (6) Weak bones which easily fracture.

Daily requirements

The daily requirements of vitamin C are given in Table 24.

Table 11. **Vitamin C (Ascorbic acid)—Important sources**

Fruits	*Vitamin C* (*mg/100g.*)		*Vitamin C* (*mg/100g.*)
Amla (Indian gooseberry)	... 700	Orange	... 68
Guava	... 300	Pineapple	... 63
Lime juice	... 63	Mango, ripe	... 24
		Papaya, ripe	... 46

	Vitamin C (*mg*/100*g*.)
Cashew fruit	60
Apple	2
Banana	1
Jack fruit	10
Tomato, ripe	32
Green leafy vegetables	
Amaranth leaves	173
Brussels sprouts	72
Cabbage	124
Coriander leaves	135
Drumstick leaves	220
Ipomoea leaves	137
Spinach	48
Radish leaves	65
Other vegetables	
Bitter gourd	88
Brinjal	23
Cauliflower	66
Cluster beans	49
Drumstick (edible portion)	120
Knol khol	85
Ladies finger	16
Tomato, green	31
Vegetable marrow	18
Roots and Tubers	
Beet root	88
Onion	11
Potato	17
Radish	15
Sweet potato	24
Germinated pulses	10–18
Germinated Bengal gram	15
Germinated green gram	16

OTHER VITAMINS

Apart from the vitamins already mentioned, there are others which are required for human nutrition. The importance of some of these to man has not been completely established. Nevertheless, they must be present in the diet to make it really complete. The following table gives a brief account of these vitamins:

Name of the vitamin	Function as shown by animal experiments	Important sources
Vitamin E	Essential for reproduction, prevents abortion and muscular dystrophy.	Wheat germ oil, rice germ oil, cottonseed oil, groundnut oil and germs of cereals and pulses.
Vitamin K	Essential for clotting of blood.	Common leafy vegetables, cauliflower, pork liver.
Vitamin B_6 (Pyridoxine)	Essential for fatty acid and amino acid metabolism.	Rice polishings, whole cereals, wheat germ, liver, nuts, oilseeds, pulses, egg yolk, milk, curds, lettuce, spinach.

Name of the vitamin	Function as shown by animal experiments	Important sources
Pantothenic acid	Growth, maintenance of normal skin and hair, oxidation of carbohydrates and fats.	Cereals, pulses, nuts and oilseeds, liver, beef, pork, kidney, eggs.
Biotin ...	Deficiency causes skin changes, lassitude, loss of appetite and slight anaemia.	Liver, kidney, chicken, milk, spinach, peas.
Inositol ...	Prevents accumulation of fat in the liver.	Present in all foods.
Choline ...	Prevents accumulation of fat in the liver, necessary for formation of acetylcholine and phospholipids.	Cereals, pulses, nuts and oilseeds, pork, liver, eggs, milk.

Note: A balanced diet normally contains adequate amounts of all the above vitamins.

VII. MINERALS

The body contains 19 minerals, all of which must be derived from food. These include calcium, phosphorus, potassium, sodium, chlorine, magnesium, iron, manganese, copper, iodine, cobalt, zinc, aluminium, arsenic, bromine, fluorine and molybdenum.

These minerals are necessary for four main purposes:

(1) As constituents of bones (*i.e.* the rigid structures which support the muscular system of the body) and teeth. Minerals having this function are calcium, phosphorus and to a lesser extent, magnesium.

(2) As constituents of body cells, of which muscle, blood corpuscles, liver, etc., are composed. Minerals having this function include iron and phosphorus.

(3) As soluble salts which give to the body fluids their composition and stability which are both essential for life. Among elements which serve this purpose are sodium, potassium, chlorine and phosphorus.

(4) Some minerals are required in small quantities for specific functions *e.g.* (*a*) iron and copper—formation of haemoglobin (*b*) iodine—formation of thyroxine (*c*) zinc—constituent of an enzyme and (*d*) cobalt—constituent of vitamin B_{12}.

In poor Indian dietaries, deficiencies of calcium and iron commonly occur. Iodine deficiency occurs in human beings in certain hilly tracts in India. Addition of extra sodium chloride to the diet is of special importance in a tropical country like India. The deficiencies of other minerals do not normally occur in average diets.

CALCIUM AND PHOSPHORUS

Functions of Calcium and Phosphorus

(1) They form the major constituents of bones and teeth and are essential for their formation.

(2) They are present as soluble salts in all the fluids of the body and they supply the necessary electrolytes for the action of muscles and nerves.

(3) Calcium participates in blood coagulation.

(4) Phosphorus plays an essential part in the complex processes by which the body obtains the release of energy from the carbohydrates and fats.

Effects of calcium deficiency

Calcium deficiency may cause the following effects:

(1) Rickets (as in Vitamin D deficiency) (2) Tetany (3) Hyperirritability (4) Decay of the teeth and (5) Excessive bleeding due to delayed coagulation.

Daily requirements of calcium

The daily requirements of calcium are given in Table 24.

Table 12. **Important sources of Calcium**

	Calcium (g./100g.)
Milk and Milk products	
Milk, cow's	0·12
Milk, buffalo	0·21
Milk, goat	0·17
Curds from cow's milk	0·12
Milk powder, skimmed	1·37
Milk powder, whole	0·95
Cheese	0·79
Khoa (from whole buffalo milk)	0·65
Cereals	
Ragi	0·33
Pulses	
Bengal gram dhal	0·19
Black gram dhal	0·20
Green gram dhal	0·14
Red gram dhal	0·14
Nuts and oilseeds	
Gingelly (sesame) seeds	1·45
Almond	0·23
Green leafy vegetables	
Sesbania leaves	1·13
Amaranth ,,	0·50
Carrot ,,	0·34
Curry ,,	0·81
Drumstick ,,	0·44
Mint	0·20
Flesh foods	
Small fish, dried	1·8

Note: 1. Milk, green leafy vegetables, ragi and gingelly seeds are the most important sources of calcium in the diet.

2. Rice is a poor source of calcium.

Table 13. **Important sources of Phosphorus**

	Phosphorus (g./100g.)
Milk and Milk products	
Milk, cow's	0·09
Milk, buffalo	0·13
Milk powder, skimmed	1·00
Milk powder, whole	0·73
Cheese	0·52
Khoa (from whole buffalo milk)	0·42
Flesh Foods	
Egg, hen's	0·22
Egg, duck's	0·26
Fish	0·41
Mutton	0·24
Liver, sheep	0·38
Cereals	
Bajra (Cambu)	0·35
Barley	0·23
Cholam (Jowar)	0·28
Italian millet	0·29
Maize (Corn)	0·33
Oatmeal	0·38
Ragi	0·27
Rice, raw, husked	0·23
Rice, raw, home-pounded	0·21
Rice, raw, milled	0·11
Rice, parboiled, home-pounded	0·22
Rice, parboiled, milled	0·17

	Phosphorus (g./100g.)
Wheat, whole	0·32
Wheat flour (maida)	0·09
Pulses	
Bengal gram dhal	0·31
Black gram dhal	0·37
Cow gram	0·49
Field bean, dry	0·45
Green gram dhal	0·28
Horse gram	0·39
Lentil (Masur dhal)	0·25
Peas, dried	0·30
Red gram dhal	0·26
Soya bean	0·69
Nuts and oilseeds	
Almond	0·49
Cashew nut	0·45
Cocoanut, fresh	0·24
Gingelly seeds	0·57
Groundnut	0·39

Note: 1. Most of the common foodstuffs are rich in phosphorus.
2. The phosphorus present in milk and animal foods is available to a greater extent than that present in cereals, pulses, nuts and oilseeds.

IRON

Functions

Iron is present in haemoglobin, which is an important constituent of the red blood cells. Haemoglobin has the important function of transporting oxygen to the tissues. Iron is required for the formation of haemoglobin.

Effects of deficiency

Prolonged deficiency of iron in the diet prevents the formation of haemoglobin and hence causes the disease known as *anaemia.*

Daily requirements

The daily requirements of iron are given in Table 24.

Table 14. **Important sources of Iron**

	Iron (mg/100g.)
Cereals	
Bajra (Cambu)	8·8
Jowar (Cholam)	6·2
Ragi	5·4
Rice, raw, milled	2·8
Rice, raw, home-pounded	3·6
Rice, raw, husked	4·5
Rice, parboiled, milled	3·2
Wheat, whole	5·3
Pulses	
Bengal gram dhal	8·9
Black gram dhal	9·8
Green gram dhal	8·4

	Iron (mg/100g.)
Horse gram	7.6
Peas, dried	4.4
Red gram dhal	8.8
Soya bean	11.3
Miscellaneous foods	
Betel leaves	5.7
Jaggery	11.4
Nuts and Oilseeds	
Cashew nut	5.0
Gingelly seeds	10.5
Groundnut	1.6
Green leafy vegetables	
Amaranth, tender	21.4
Coriander leaves	10.0
Fenugreek leaves	16.9
Mint	15.6
Spinach	5.0
Other vegetables	
Bitter gourd	9.4
Cluster beans	5.8
Tomato, green	2.4
Flesh foods	
Egg, hen's	2.1
Fish	2.3
Liver, sheep	6.3
Mutton	2.5

Note: Milk is a poor source of iron.

IODINE

Iodine is a constituent of *thyroxine*, the active principle of *thyroid gland*. Thyroid gland plays an important part in energy metabolism and in the growth of the body. Iodine is required for the formation of *thyroxine*.

Iodine deficiency in human beings

If sufficient iodine is not taken in the diet, enlargement of the thyroid gland takes place, resulting in the disease called *goitre*. In India *goitre* occurs in persons living in the hilly regions along the foot of the Himalayas.

Important sources of iodine

Iodine occurs only in small amounts in common foods. The iodine content of foods depends on the iodine content of the soil. Foods grown in hilly regions contain less iodine than those grown in the plains. Crude common salt (prepared from sea water) and sea fish are the richest natural sources of iodine.

Iodine requirements

Iodine requirement of adults is about 0.2 mg. daily. This is normally supplied by well-balanced diets and drinking water, except in hilly regions where the food and water may be deficient in iodine.

SODIUM CHLORIDE

All minerals, except sodium chloride, are usually present in sufficient amounts in a balanced diet. Sodium chloride is the only mineral which is taken in more or less pure form in addition to the amount present in foods.

Effects of sodium chloride deficiency

Men doing hard work in hot humid climates and consuming a diet deficient in sodium chloride suffer from "*heat cramps*" *i.e.* intense and painful contractions of skeletal muscle. This is due to sodium chloride deficiency produced by loss of sodium chloride from the body by excessive sweating. The loss of sodium chloride may be as much as 10 to 20 g. per 8 hours of work. *Heat cramps* may be prevented by drinking water containing 0.2 to 0.5% sodium chloride.

Sodium chloride requirements

Sodium chloride requirements depend on (1) Climate (2) Occupation and (3) Physical activity. The approximate sodium chloride requirements of persons living *in the tropics* are given below:

	Sodium Chloride (g./day.)
Adults	
Light work	... 10–15
Hard work	... 15–20
Very hard work	... 25-30
Children	... 5–10
Adolescent boys and girls	... 10–25

VIII. THE NUTRITIVE VALUE OF FOODSTUFFS

Foods may be broadly classified into 10 groups based on their nutritive value: (1) Cereals and millets (2) Pulses (3) Nuts and oilseeds (4) Vegetables: (*a*) Leafy vegetables (*b*) Roots and tubers and (*c*) Other vegetables (5) Fruits (6) Milk and milk products (7) Eggs (8) Meat, fish, liver etc. (9) Fats and Carbohydrate foods (10) Condiments and spices. The nutritional significance of the different groups of foods is briefly described below:

1. Cereals and Millets

Cereals and millets constitute by far the most important of foodstuffs throughout the world. Their protein content varies from 6–12%. In Africa, South America, India and several Asian countries, they supply 70 to 80% of the calories and protein in the diet of the people. They are also important sources of B-vitamins and minerals in such diets. The nutritive value of some of the important cereals and millets is given in Table 36. All cereals, except ragi, are poor to moderate sources of calcium. Rice is the poorest of all in calcium content. *Ragi is one of the richest sources of calcium.* Cereals do not contain vitamins A, D, B_{12} and C. Yellow maize, however, contains fair amounts of carotene (Provitamin A).

2. Pulses

Pulses are rich in proteins, containing about 20-25%. They are also good sources of B-vitamins and minerals. They contain only traces of carotene but do not contain vitamins D and B_{12}. Dried pulses do not contain any vitamin C but germinated pulses are good sources of vitamin C. Tender pulses like green peas, green Bengal-gram and green field beans are also good sources of

vitamin C. The chemical composition of some important pulses is given in Table 36.

3. Nuts and Oilseeds

Nuts and oilseeds are, in general, (except cocoanut) rich sources of protein, containing about 18-28%. They are also rich sources of fat. Nuts and oilseeds are good sources of minerals and B-vitamins. Gingelly (sesame) seed is particularly rich in calcium. Nuts and oilseeds do not contain any vitamin A, D, C and B_{12}. In view of their richness in protein and fats, they can be used for preparing vegetable milk substitutes (see chap. IX) which can be given to infants over 6 months and to young children.

4. Vegetables

(*a*) *Green leafy vegetables*: Green leafy vegetables are very rich sources of *carotene* (Provitamin A). They are also good sources of *calcium*, *riboflavin*, *folic acid* and *vitamin C*. The daily diet should include at least 2-4 ounces of green leafy vegetables depending upon the age of the subject. They are the cheapest among the protective foods.

(*b*) *Roots and tubers* : The important foods in this group are potato, sweet potato (white and yellow flesh), tapioca, carrot, elephant yam and colocasia. Roots and tubers are good sources of *carbohydrates*. Some of them are also good sources of vitamin C. Carrots and yellow flesh variety of sweet potato are also rich sources of *carotene* (Provitamin A), but potato, white flesh variety of sweet potato and tapioca do not contain carotene. Potato is moderately rich in proteins while sweet potato and tapioca are poor sources. *Nevertheless, all the three foods can serve as partial substitutes for cereals in the diet.* In view of the high yield of calories per acre, sweet potato and tapioca

are the cheapest among the energy yielding foods (See Chapter XIV-Subsidiary foods).

(*c*) *Other vegetables*: This group includes all vegetables other than those included in the above category. Some of them are fair sources of vitamin C and minerals.

5. Fruits

Fruits are, in general, good sources of vitamin C. Some of them (mango and papaya) are also moderately rich sources of carotene (Provitamin A). Indian gooseberry (*Amla*) and guava are very rich sources of vitamin C. Other good sources of vitamin C are tomato, citrus fruits, papaya, cashew fruit and pine apple. Apple and banana are only fair sources of vitamin C.

6. Milk and Milk products

Milk is universally regarded as an ideal food for nourishing infants and young children. It is also a good supplementary food in the diet of adults. *Milk is the most complete of all foods, containing the different nutrients in the proper proportions.* It is, however, deficient in iron and contains only small amounts of vitamins C and D. The chemical composition of milk of different mammals and of some milk products is given in Table 36.

It is evident that the milk of cow, buffalo and goat is richer in all dietary essentials (except lactose) than human milk. Buffalo milk is richer in fat than cow's or goat's milk. *Sour curd* prepared from milk by seeding with *lactobacillus* contains some lactic acid. The nutritive value of the curd is similar to that of the milk.

Whole milk powder: Whole milk powder is about 8 times as rich as fresh milk in all nutrients except vitamin C which is mostly destroyed during drying. When reconstituted with 7 times its weight of water, the reconstituted

milk has almost the same composition as that of fresh milk.

Skimmed milk powder: Skimmed milk powder is prepared from milk from which the fat has been removed. Hence it contains very little fat and only negligible quantities of vitamins A and D. It is richer than whole milk powder in proteins, B-vitamins and minerals. *Since it is deficient in fat and vitamins A and D, it is not suitable for feeding infants.* It can, however, be used as a supplement to the diets of children and adults.

Sweetened condensed milk: This is about $2\frac{1}{2}$ times as rich as fresh milk and contains in addition about 45% cane sugar. *It is not suitable for feeding infants* as it contains too much of sugar. It may, however, be given as a supplement to the diets of children and adults.

7. Eggs

Hen's egg is a highly nutritious food containing about 13% protein of high biological value and 13% fat (rich in lecithin). It is also a rich source of vitamin A and B-vitamins. It is a fair source of vitamin D but does not contain any vitamin C. The chemical composition of duck's egg is similar to that of hen's egg. Duck's egg, however, contains a substance called 'trypsin inhibitor' which lowers the nutritive value of the proteins and hence should not be consumed *in the raw state.* The 'trypsin inhibitor' is destroyed when the egg is boiled. *Egg white* contains only protein and B-vitamins while *egg yolk* contains protein, fat (rich in lecithin) and vitamins A, B-complex and D. The chemical composition of hen's and duck's egg is given in Table 36.

8. Liver, Meat and Fish

Liver: Liver is rich in proteins (18-20%) of high biological value and vitamins A and B-complex. *It is the*

richest natural source of vitamin B_{12}—the antipernicious anaemia factor.

Meat: Meat is rich in proteins (18-22%) of high biological value. It is a fair source of B-vitamins. It does not contain any vitamin A, C or D.

Fish: Fish is rich in proteins (18-22%) of high biological value. It is a fair source of B-vitamins. Fatty fish contain some vitamin A and D. Large fish are rich in phosphorus but are deficient in calcium. Small fish, eaten with bones, are good sources of calcium.

9. Fats and Oils and Carbohydrate foods

Fats and Oils: Fats and oils serve mainly as sources of energy. *Ghee, butter and vanaspati (hydrogenated groundnut oil) contain about 750 I.U. of vitamin A per ounce.* The common vegetable oils and fats consumed in India do not contain carotene or vitamin A. Vanaspati and all vegetable oils are good sources of vitamin E.

Carbohydrate foods: The carbohydrate foods commonly used are cane sugar, jaggery, glucose, honey, syrup, custard powder, arrowroot flour and sago. They serve mainly as a source of energy. Honey contains, in addition to sugars, small quantities of minerals and vitamins.

10. Condiments and Spices

Condiments and spices are commonly used to enhance the palatability of foods. The essential oils present in them have carminative properties and may aid digestion by stimulating the appetite and the secretion of digestive juices. Certain spices, namely garlic and asafoetida, contain active principles which correct digestive disorders by inhibiting the growth of putrefactive bacteria in the intestinal tract.

IX. VEGETABLE MILK AND CURDS

The minimum daily requirements of milk for a balanced diet have been estimated at 10 ounces for adults and 15-25 ounces for children and infants. As against this, the *per capita* availability of milk and milk products in India is highly inadequate, being of the order of 5 ounces only (Appendix I). In countries like China, Japan and Indonesia, milk prepared from soya bean has been used as a substitute for cow's milk for feeding infants and children for the past several centuries. A thorough study of the method of preparation and the nutritive value of milk and curd from soya bean and groundnut has been carried out at the Central Food Technological Research Institute, Mysore. The processes for their preparation are briefly described below:

Preparation of soya bean milk and curds

Removal of husk: Soya bean is soaked in water for 2-4 hours and dried in the sun. The husk is removed by means of a wooden huller. The dhal thus obtained can be preserved for long periods. The dhal (one pound) is soaked in water overnight. Alternatively soya bean (one and half pounds) is soaked in water overnight. The husk is removed by rubbing and washing in water.

Removal of bitter principle: The soaked soya bean dhal is added to warm water (6 cups) containing half a teaspoon of sodium bicarbonate (cooking soda) and allowed to soak for about 10 minutes to remove the bitter principle and colouring matter present. The water is drained off.

Preparation of milk: The washed soya bean dhal is made into fine paste in a stone grinder with the addition of a small amount of water. The paste is stirred in water (15 cups). The mixture is boiled for 15 minutes, allowed

to cool slightly, and then strained through cloth. About half a cup of clear lime water (calcium hydroxide solution) is added. Sugar and common salt (½ teaspoon) are added to improve the taste. The residue can be used for food preparations like *dosai*, *vadai*, etc. The nutritive value of the milk is given in Table 15.

Preparation of curds: Two teaspoons of glucose powder, invert sugar or honey are added to 4 cups of milk. The milk is allowed to cool, seeded with a small quantity of cow's milk curds and allowed to remain for 12 hours to set. Soya bean curd is thus obtained.

Preparation of Groundnut milk and curds

Roasting of groundnut and removal of red skin: Good quality groundnut is given light roasting in a pan. The shell is removed. Alternatively, if good quality groundnut kernel is available, it may be roasted lightly. The red skin is removed by rubbing and the spoilt kernels are picked out.

Preparation of milk: The decuticled groundnut kernel (one pound) is soaked in water for about 3 hours. The water is drained off. The soaked kernel is made into fine paste in a stone grinder. The paste is mixed with 15 cups of cold water. Half a cup of clear lime water (calcium hydroxide solution) is added. One-quarter teaspoon of sodium bicarbonate dissolved in a little water is next added to stabilise the milk. *Excess of lime water and sodium bicarbonate should not be added.* The groundnut milk is strained through mull cloth and boiled for 5 minutes. Sugar may be added to taste if the groundnut milk is to be consumed as such.

Preparation of groundnut curds: Two teaspoons of glucose powder, invert sugar or honey are added to 4 cups of milk. The milk is allowed to cool, seeded with a small

quantity of cow's milk curds and allowed to remain overnight to set. The curds can be used in the same way as cow's milk curds along with rice and for such preparations as *dahibada*, butter milk etc.

Nutritive value of vegetable milk and curds : The nutritive value of soya bean and groundnut milks as compared with cow's milk is given in Table 15. The curd has almost the same composition as the milk. *Feeding trials on infants have shown that soya bean milk can be used as a substitute for cow's milk for infants over 6 months of age. Groundnut and soya bean curds have been found to possess a marked supplementary value to the diet of children.*

Table 15. **Nutritive value of soya bean and groundnut milks as compared with cow's milk** (Values per 100g.)

Nutrients	Soya bean milk	Groundnut milk	Cow's milk
Protein (g)	4·2	3·0	3·2
Fat (g)	2·4	5·2	4·9
Carbohydrate (g)	3·2	3·1	4·6
Calcium (g)	0·08	0·11	0·11
Phosphorus (g)	0·104	0·102	0·70
Iron (mg)	1·2	1.47	0·2
Calorific value	51	71	75
Thiamine (mg)	0·042	0·085	0·045
Riboflavin (mg)	0·04	0·03	0·17
Nicotinic acid (mg)	0·24	1.11	0·1

Note: One teaspoonful of shark liver oil or vitamin A and D concentrate should also be used daily along with soya bean and groundnut milks, to supply vitamins A and D.

X. NUTRITIONALLY BALANCED MALT FOOD

In our country where the *per capita* production of milk is low, the problem of supplying adequate nutrition to the weaned infants and young children has become very difficult. The children of the poorer classes after weaning are

generally fed on cooked cereals or cereal gruels, both of which have a low protein content and are deficient in many essential vitamins and minerals. The incidence of protein malnutrition and vitamin deficiency diseases is consequently quite high among the children of the poorer classes. With a view to meeting the shortage in the supply of milk, the Central Food Technological Research Institute has developed processes for the preparation of vegetable milk substitutes from groundnut and soya bean (Chap. IX). *Another product which is also highly nutritious and which can be prepared in the home is the nutritionally balanced malt food.* The method of preparation of the malt food is as follows.

Preparation of malt from ragi or cholam

Good quality seed grains (with percentage germination not less than 95) should be taken for preparing malt. The process involves the following steps:

(1) *Cleaning and steeping of the grain:* The grain is first cleaned free of mud, stones etc. by winnowing and then washed well in water. It is then steeped in water in a tall vessel, so that the grain is not more than one third the height of the vessel. The water is changed in the morning and evening.

(2) *Couching:* After the grain is steeped for 24 hours, it is taken out of the steeping vessel and spread on a clean gunny matting in a cool dark place. The depth of the grain should not be more than 2″. A second wet gunny matting or cloth is used for covering the wet grain. At the end of every 24 hours, the cover is removed and the grain is piled up in the centre of the bottom gunny and wetted with a little water. The grain is well mixed and spread again as before. The couching period is usually 72 hours.

(3) *Drying*: The grain is then taken out and spread either in trays or on a clean cement floor and allowed to dry in the sun. When the grain is completely dry, it is placed on a dry gunny sack and gently rubbed to separate the vegetative portion from the grain. The vegetative portion is removed by winnowing.

(4) *Roasting, powdering and sieving:* The grain is next roasted lightly in an iron pan to develop the characteristic malt flavour. Over roasting should be strictly avoided as this will affect adversely the malt flavour. The roasted grain is powdered to a fine flour and passed through a 70-80 mesh sieve.

The malt flour thus obtained can be preserved in air tight tins for a period of about one month.

Nutritive value: During malting, a part of the starch present in the grain is converted into dextrins and maltose. Hence malt is more readily digested by infants than cereal flours. There is also a slight increase in the content of B-vitamins. There is practically no change in the content of proteins and minerals.

Preparation of roasted Bengal gram flour

Bengal gram dhal is cleaned free of grits and foreign matter and roasted in a pan till a pleasant aroma develops. The roasted Bengal gram dhal is powdered in a flour mill. Puffed Bengal gram dhal obtained from the market can be used in place of roasted Bengal gram dhal.

Preparation of nutritionally balanced malt food

One pound of ragi malt flour is mixed with one pound of roasted or puffed Bengal gram dhal flour and half a pound of skimmed milk powder. The malt food can be kept in closed tins for a period of one to two months. The nutritive value of the malt food as compared with that of ragi malt is given in Table 16.

Table 16. **The nutritive value of Malt and Malt food**

Nutrients	Values per 100g	
	Ragi Malt	Nutritionally balanced malt food*
Protein (g)	6·2	19.0
Fat (g)	1·2	1.1
Carbohydrate (g) ...	79·5	68.5
Calcium (g)	0·32	0.45
Phosphorus (g)	0·28	0.36
Iron (mg)	2·5	2.4
Vitamin B_1 (mg)	0·36	0.38
Riboflavin (mg)	0·11	0.54
Nicotinic acid (mg) ...	1·8	1.7

* A daily supplement of half a teaspoon of shark liver oil should be given to supply vitamins A and D.

Cost

The cost of the malt food will be only about 40-50 naye paise per lb.

Chemical composition

The malt food is rich in protein, calcium and riboflavin. It can be made into a porridge or pudding by cooking in the required amount of water and adding sugar to taste. Consumption of 2 ounces of malt food daily will provide liberal amounts of protein, calcium and riboflavin and *will thus form a good supplement to the diets of weaned infants and young children.*

XI. INDIAN MULTIPURPOSE FOOD

It is a well recognised fact that malnutrition is widely prevalent among the poorer sections of the population in the different parts of the country. Protective foods like milk, eggs, meat and fish are costly and are not available in adequate quantities (Appendix I). In view of this,

investigations were undertaken at the Central Food Technological Research Institute, Mysore, for developing a food supplement rich in proteins, vitamins and minerals and known as Indian Multipurpose Food (MPF). It is prepared from specially processed groundnut flour and Bengal gram flour and is fortified with essential minerals and vitamins. Its nutritive value is similar to that of the multipurpose food distributed by the Meals for Millions Foundation of U.S.A. The food can be easily incorporated in our diets, thus enhancing their nutritive value. It does not require any change in our food habits. It can be used as a low cost supplement to the diets of the vulnerable sections of the population. One ounce of this food will cost about *four naye paise* and will supply a fair portion of the daily requirements of proteins, minerals and vitamins for adults and children.

Different forms

It is available in 3 forms:

(A) *Seasoned:* With salt and spices for use in the preparation of savoury dishes and dhal substitute.

(B) *Unseasoned:* For use in sweet dishes such as toffees, porridge and pudding.

(C) *Unseasoned with 20% skimmed milk powder:* For use in porridge and pudding for feeding weaned infants and convalescents and for the treatment of protein malnutrition.

Nutritive value

The following table (Table 17) gives the nutritive value of Indian MPF as compared with the American MPF, Bengal gram dhal and skimmed milk powder. It will be noted that the *Indian multipurpose food contains about twice as much protein and 2 to 4 times as much calcium, thiamine and riboflavin as Bengal gram dhal and other pulses.*

Further, it is a good source of vitamins A and D in which pulses and skimmed milk powder are deficient.

Table 17. **The chemical composition of Indian MPF as compared with that of American MPF, Bengal gram dhal and skimmed milk powder**

(Values per 100g.)

Nutrients	Indian MPF	Bengalgram dhal	American MPF	Skimmed milk powder
Protein (g) ...	42·9	22·3	42·3	35·6
Fat (g)	8·5	5·2	7·6	1·0
Carbohydrate (g) ...	35·8	58·9	36·9	52·0
Calcium (g)	0·665	0·07	0.587	1·3
Phosphorus (g) ...	0·820	0·31	0.440	1·03
Iron (mg)	5·1	8·9	7·0	0·6
Thiamine (mg) ...	1·3	0·32	0·7	0.35
Nicotinic acid (mg) ...	14·3	2·6	7·0	1·1
Riboflavin (mg) ...	3·0	0·21	1·2	1·96
Vitamin A (I.U.) ...	3000	...	2940	40
,, D (I.U.) ...	300	nil	235	nil
Calorific value ...	387	372	386	359

Consumer acceptability trials have shown that both the *seasoned* and *unseasoned* varieties can be incorporated in preparations based on cereals and pulses up to 25-50% levels in the average diets.

Feeding experiments on children have shown that supplementation of the usual diet with 2 ounces of MPF for a period of five months produces a significant increase in the growth and nutritional status of the children. Indian MPF containing skimmed milk powder (formula C) has been successfully employed in treating several cases of protein malnutrition in children.

Several recipes containing Indian MPF have been standardised. Recipe booklets are available on request from the Information and Statistics Division, Central Food Technological Research Institute, Mysore.

XII. NUTRITIVE VALUE OF WHEAT AND WHEAT PRODUCTS

The wheat grain consists of the following parts (1) the endosperm which makes up about 85% of the whole grain (2) the pericarp and aleurone layer together constituting the bran and making up about 13% of the grain and (3) the germ which makes up about 2% of the whole grain. Whole wheat flour, white flour and semolina (*Suji* or *Rava*) are widely consumed in India. The nutritive value of the three products is given in Table 18.

Table 18. **Chemical composition of wheat products**

(Values per 100g.)

	Protein (g)	Fat (g)	Fibre (g)	Carbo-hydrate (g)	Calcium (g)	Phosphorus (g)	Iron (mg)	Vitamin B_1 (mg)	Nicotinic acid (mg)
Whole wheat flour	11·8	1·5	1·2	71·2	0·050	0·320	5·3	0·54	5·0
White flour (70–72% extraction)	10·2	0·8	0·2	74·8	0·016	0·106	1·5	0·12	1·2
Semolina (*Suji*) ...	10·4	0·8	0·2	74·8	0·016	0·102	1·6	0·12	1·2

Whole wheat flour: Whole wheat flour is obtained by grinding cleaned wheat in a flour mill. It contains the germ and the bran. It is richer than white flour in proteins, vitamin B_1, nicotinic acid and other B-vitamins.

White flour (Maida flour): White flour is obtained by milling whole wheat so as to remove the bran and the germ. White flour consists mostly of the endosperm of wheat and is practically free from the bran and the germ.

It usually represents about 70-75 per cent extraction. It is a poor source of B-vitamins.

Semolina (*Suji* or *Rava*)*:* Semolina consists mostly of the endosperm. Its nutritive value is similar to that of white flour. It is a poor source of B-vitamins as compared to whole wheat flour.

Bread

Bread is made from the dough of wheat flour to which salt and sugar have been added. The dough is allowed to ferment after the addition of yeast under controlled conditions and then baked. During baking, the bread rises due to the escape of carbon dioxide, yielding a porous structure.

White bread: White bread is prepared from white flour. It is easily digestible due to its low fibre content but is a poor source of B-vitamins.

Brown bread: Brown bread is prepared from whole wheat flour. It is a richer source of B-vitamins than white bread. It contains a fair amount of fibre.

The chemical composition of white and brown breads is given in Table 19.

Table 19. **Chemical composition of bread**
(Values per 100g.)

	Protein (g)	Fat (g)	Fibre (g)	Carbo-hydrate (g)	Calories	Calcium (g)	Iron (mg)	Vitamin B_1 (mg)	Nicotinic acid (mg)
White bread ...	7·8	0·7	0·2	51·9	245	0·011	1·1	0·04	0·7
Brown bread ...	8·8	1·4	1·2	49·0	246	0·018	2·2	0·21	2·5

XIII. THE EFFECT OF MILLING, WASHING AND COOKING ON THE NUTRITIVE VALUE OF RAW AND PARBOILED RICE

The effect of milling on the nutritive value of raw rice

The rice grain is composed of three parts (*a*) the outer layer or pericarp (*b*) the inner starchy kernel or endosperm (*c*) the germ or embryo. As a result of milling of rice, the pericarp and the germ are removed. These two parts are rich in vitamins of the B-complex. The nutritive value of husked, undermilled (or home-pounded) and highly milled rice is given in Table 20.

Table 20. **Composition of rice**

	Protein%	Calcium%	Phosphorus %	Iron (mg)%	Vitamin B_1 (mg)%	Nicotinic acid (mg)%
Raw, husked rice ...	7.7	0.015	0.368	4.0	0.40	3.5
Raw, undermilled or home-pounded rice (about 7% polishings removed)	7.2	0.013	0.146	2.2	0.22	2.2
Raw, milled rice (about 14% polishings removed) ...	7.0	0.010	0.110	2.0	0.11	1.0

The above values show that

(*a*) Milling of raw rice removes a greater part of vitamin B_1 and nicotinic acid (and also other B-vitamins) present in the rice.

(*b*) Since raw milled rice is a poor source of B-vitamins, undermilled or home-pounded rice should be consumed in preference to milled rice.

Effect of parboiling on the nutritive value of rice

Parboiling of paddy has been practiced in India for many centuries. During the process of parboiling, the B-vitamins present in the pericarp and the germ penetrate into the endosperm and are not lost during milling. It is important to note that *parboiled milled rice is a rich source of vitamin B_1 and nicotinic acid in contrast to raw milled rice which is a poor source.*

The vitamin B_1 and nicotinic acid contents of parboiled undermilled and milled rice samples are given below:

	Vitamin B_1 (mg/100g.)	*Nicotinic acid (mg/100g.)*
Parboiled undermilled rice (7% polishings removed)	0·32	3·5
Parboiled milled rice (14% polishings removed)	0·24	2·4

The process of parboiling at present adopted by the industry yields a rice having an off-flavour. The Central Food Technological Research Institute has made improvements in the process of parboiling for eliminating the bad smell present in the commercial samples. The improved process consists in soaking the paddy in hot water at 70°-75° C for 4 hrs. and then steaming the soaked paddy. The new process is completed in 5 hrs. as compared with the old process which takes several days.

In view of its higher vitamin B-content, consumption of parboiled rice in place of raw rice is highly desirable.

Effect of washing and cooking on the vitamin B_1 and nicotinic acid contents of rice

Rice is generally washed and then cooked in excess of water. The gruel present in cooked rice is usually drained off. These procedures cause a marked loss of vitamin B_1 and nicotinic acid (and other B-vitamins) in the case of

home-pounded and milled raw rice. *The losses of B-vitamins are very much less in the case of home-pounded and milled parboiled rice.* The results are given in Table 21.

Table 21. **Effect of washing and cooking on vitamin B_1 and nicotinic acid contents of raw and parboiled rice**
(Values per 100g. original rice)

Treatment	Parboiled home-pounded rice		Parboiled milled rice		Raw home-pounded rice		Raw milled rice	
	Vit. B_1 (mg)	Nicotinic acid (mg)	Vit. B_1 (mg)	Nicotinic acid (mg)	Vit. B_1 (mg)	Nicotinic acid (mg)	Vit. B_1 (mg)	Nicotinic acid (mg)
Original rice ...	0·32	3·5	0·24	2·4	0·22	2·2	0·11	1·0
Washed rice ...	0·29	3·2	0·22	2·1	0·10	1·1	0·07	0·6
Washed and cooked* rice...	0·16	1·9	0·13	1·5	0·06	0·5	0·04	0·3

* Gruel removed.

It is evident that *washed and cooked raw milled rice is a very poor source of vitamin* B_1 *and nicotinic acid while washed and cooked parboiled milled rice is a good source of the two vitamins.*

XIV. SUBSIDIARY FOODS

Tapioca, potato, sweet potato and low-fat groundnut flour

In view of the shortage in the supply of cereals in the country, there is a need to supplement the diet by other foods rich in calories. *These foods should be such that they give larger yields of calories per acre than cereals and can be cultivated easily both as a kitchen garden crop and on a*

field scale. The most important of such foods are the roots and tubers such as tapioca, sweet potato and potato. In view of the fact that these foods contain less protein than cereals, they could serve mainly as a source of energy in the diet. At the same time a food rich in protein should be included in the diet to meet the protein needs. Investigations conducted at the Central Food Technological Research Institute have shown that specially prepared low-fat groundnut flour forms a good supplement to diets based on tapioca and sweet potato flours and a mixture of 75 parts of tapioca flour and 25 parts of groundnut flour (known as Mysore flour) has a nutritive value equal to that of common cereals. The chemical composition of tapioca, sweet potato, potato and low-fat groundnut flour is given in Table 22.

Utilisation of tapioca, sweet potato and potato as partial substitutes for cereals

Tapioca, sweet potato and potato are being consumed in different parts of the world as partial substitutes for cereals (See Appendix I). Investigations carried out at the Central Food Technological Research Institute have shown that 25 per cent of cereals in the diet could be replaced by tapioca flour or sweet potato flour without affecting the overall nutritive value of the diet. A daily consumption of 8 ounces of fresh roots and tubers will help considerably in making up the calorie deficiency in poor Indian diets; such a step will also help to overcome the shortage of cereals in the country (Appendix I).

Utilisation of a mixture of tapioca flour and groundnut flour (Mysore flour) as partial substitute for cereals

A blend of 75 parts of tapioca flour and 25 parts of groundnut flour (known as Mysore flour) can be used as a partial substitute for cereal flours. Experiments on school

children have shown that 50 per cent of the cereals in the diet can be replaced by Mysore flour without affecting the growth and health of children. The flour can be used in admixture with wheat flour for the preparation of *chapatis* and *purees*. Gruel prepared from Mysore flour was also used during 1953 for the large scale feeding of people in food scarcity areas in the Madras State.

Tapioca macaroni

As a result of work done at the Central Food Technological Research Institute, a process for the preparation of tapioca macaroni from a blend of tapioca flour (60 parts), groundnut flour (15 parts) and semolina (25 parts) has been standardised. The nutritive value of tapioca macaroni as compared with that of natural rice is given in Table 22. The data show that tapioca macaroni is

Table 22. **Chemical composition of subsidiary foods**

(Values per 100g.)

Name of foodstuff	Protein (g)	Fat (g)	Carbohydrate (g)	Calorific value	Calcium (g)	Phosphorus (g)	Thiamine (mg)	Riboflavin (mg)	Nicotinic acid (mg)
Potato, fresh ...	1.6	0.1	22.9	99	0.01	0.03	0.10	0.01	1.2
Sweet potato, fresh	1.2	0.3	31.0	132	0.02	0.05	0.08	0.04	0.7
Tapioca, fresh ...	0.7	0.2	38.7	159	0.03	0.04	0.04	0.02	0.5
Tapioca flour ...	1.7	0.5	85.5	353	0.06	0.08	0.12	0.04	1.0
Groundnut flour ...	52.7	8.9	21.8	378	0.07	0.50	0.95	0.20	19.5
Mysore flour* ...	13.8	2.7	69.8	363	0.06	0.18	0.31	0.07	5.4
Tapioca macaroni	10.5	1.9	73.8	378	0.05	0.14	0.22	0.07	3.7
Rice, raw, milled...	7.0	0.6	79.3	350	0.01	0.11	0.11	0.03	1.0

* A mixture of tapioca flour (75 parts) and groundnut flour (25 parts).

richer than natural rice in protein, calcium and B-vitamins. Feeding experiments with animals have shown that the growth promoting value of a poor vegetarian diet based on tapioca macaroni is about twice that obtained with rice diet.

Feeding experiments on children have shown that when rice in poor rice diet is replaced completely by tapioca macaroni, the growth and health of children are not affected. The retention of nitrogen, calcium and phosphorus on the tapioca macaroni diet is greater than that observed on the rice diet.

XV. FOOD PRODUCTION IN INDIA AND FOOD REQUIREMENTS

Diet surveys carried out during the last 20 years in different parts of India have revealed that the average diets consumed by the poorer classes of people are not satisfactory from the nutritional standpoint and are lacking in protective foods such as milk, eggs, meat, fish, fruits and leafy vegetables. Data regarding the average production of different types of foods *per adult consumption unit* as compared with the requirements for a *balanced diet* suggested by the Nutrition Advisory Committee are given in Table 23.

Calories

The calories available *per consumption unit* per day are only 2238 as compared with 3000 calories recommended for a balanced diet by the Nutrition Advisory Committee. The calorie deficit can be easily made up by the daily consumption of 4-6 ounces of a blend of tapioca flour and low-fat groundnut flour.

Table 23. **Estimated availability of different foodstuffs as compared to the requirements of a balanced diet (ounces per adult consumption unit per day)**

Foodstuffs	Balanced diet* (per adult consumption unit)	Estimated† availability per adult consumption unit (1955–56)
Cereals ...	14	14.7
Pulses ...	3	2.6
Leafy vegetables ...	4	2.6
Other vegetables ...	6	
Ghee and vegetable oils ...	2	0.39
Milk and milk products ...	10	4.5
Meat, fish and eggs ...	4	0.4
Fruits ...	3	1.0
Sugar and jaggery ...	2	1.6
Total calories ...	3089	2238

* Balanced diet suggested by the Nutrition Advisory Committee of the Indian Council of Medical Research, New Delhi.

† "*Indian Agriculture in brief*" issued by Economic and Statistical Adviser, Ministry of Food and Agriculture, Government of India (1958).

Cereals

The available supply of cereals is 14.7 ounces* and is just adequate for providing a balanced diet of the type recommended by the Nutrition Advisory Committee. Nevertheless, it is essential to increase the production of cereals at least by 25%, as the calories available are inadequate.

Pulses

The available supply of pulses is 2.6 ounces*, as against the recommended allowance of 3.0 ounces*. Since pulses are rich in proteins, it is desirable to increase the production of pulses by at least 50%.

* Per adult consumption unit per day.

Nuts and oilseeds

Since nuts and oilseeds are rich in proteins and fats, they form a valuable food supplement. They are the main sources of oils and fats which are in short supply. Further, nuts can be used for the production of vegetable milk and curds (Chapter IX). The oilseed meal left after the removal of oil can be used for the preparation of multipurpose food (Chapter XI). The present production of nuts and oilseeds, which is approximately of the order of 1.0 ounce*, should be doubled.

Vegetables

The present production of vegetables is only 2.6 ounces* as against the requirement of 10 ounces.* The production of green leafy vegetables and roots and tubers should be increased by 100 to 200 per cent.

Milk and milk products

The present production of milk is only 4.5 ounces* as against the requirement of 10 ounces.* Since milk is the most valuable of the protective foods and is an essential food in the diet of infants and children, the production of milk should be increased by 100-200%. The present deficit in the supply of milk can be partly made up by the production and consumption of (1) Vegetable milk and curds (Chapter IX) and (2) Indian multipurpose food (Chapter XI).

Meat, fish and eggs

The present production of meat, fish and eggs is very low (0.4 ounce*) as compared with the requirement of 4 ounces.* Immediate steps should be taken to increase the production of these foodstuffs.

* Per adult consumption unit per day.

Oils and Fats

The present production of oils and fats is very low (0.39 ounce*) as compared with the requirement of 2.0 ounces* for a balanced diet. There is a need for increasing the production of oils and fats.

Sugar and jaggery

The production of sugar and jaggery is fairly adequate to meet our requirements.

Conclusion

It is evident from the above account that the present production of cereals and protective and protein-rich foods such as milk, eggs, meat and fish is highly inadequate. Every effort should be made to increase their production. *The shortage in the supply of protective foods can be made up by the large scale production of* (*1*) *Vegetable milk and curds* (*2*) *Nutritionally balanced malt food and* (*3*) *Indian multipurpose food, as mentioned in Chapters IX-XI. The shortage in the supply of cereals can be made up by the consumption of larger amounts of roots and tubers and blends of tapioca and groundnut flours* (*Chapter XIV*).

XVI. BEVERAGES: COFFEE, TEA AND COCOA

Coffee, Tea and Cocoa are the beverages widely used all over the world. They are invigorating drinks and remove a sense of exhaustion, due to the stimulating action of substances like *caffeine* or *theobromine* present in them.

Coffee

The stimulating effect of coffee is due mostly to its content of *caffeine*. Coffee also contains some essential

* Per adult consumption unit per day.

oils which are pleasing to the taste. *Caffeine* stimulates gastric secretion and hence may aid digestion to a certain extent. It has a delaying action on the emptying time of the stomach and hence it allays a sense of hunger.

Nutritive value

The chemical composition of a cup of coffee containing 6 ozs. of decoction, 2 ozs. of milk and 15 grams of sugar is given in Table 23 A.

Effects of excess consumption

Excessive consumption of coffee is likely to be harmful, due to high intake of *caffeine*. *Caffeine* in excess produces insomnia and causes irritability and rapid heart action. It also produces increased excitability of the nervous system, particularly in the very young and the very old.

Tea

The stimulating effect of tea also is due to its *caffeine* content.

Nutritive value

Since very little milk goes into the making of a cup of tea, its nutritive value is far less than that of coffee. The nutritive value of one cup of tea containing 7 ozs. of decoction, 1 oz. of milk and 15 grams of sugar is given in Table 23 A.

Excessive consumption of tea has the same effects as excessive consumption of coffee.

Cocoa

Cocoa contains a substance called *theobromine* which has stimulating properties like *caffeine*. Cocoa by itself has a higher protein content than coffee or tea (without milk). Cocoa gives a pleasant flavour to milk. Since

more milk goes into the making of a cup of cocoa than of coffee or tea, a cup of cocoa has a higher nutritive value than a cup of coffee or tea. The chemical composition of one cup of cocoa containing 8 ozs. of milk, 6 g. of cocoa and 15 g. of sugar is given in Table 23 A.

Table 23 A. **The chemical composition of coffee, tea and cocoa** (*Values per cup*)

	Cocoa	Coffee	Tea
Protein (g)	10·0	2·14	0·9
Fat (g)	9·3	2·2	1·1
Carbohydrate (g)	27·0	18·4	18·0
Calcium (g)	0·26	0·068	0·034
Phosphorus (g)	0·20	0·063	0·025
Vitamin A (I.U.)	408	102	51
Calories	232	100	86

Taken in moderation, these beverages act as mild stimulants and add to the nutritive value of the diet, because of the milk and sugar taken along with them.

XVII. EFFECT OF COOKING ON THE NUTRITIVE VALUE OF FOODS

The object of cooking is three fold: (*i*) *Aesthetic e.g.* to improve its appearance (*ii*) *Appetising e.g.* to develop in it new flavours and (*iii*) *Hygienic e.g.* to destroy harmful organisms present and to render the food more digestible.

Cooking methods

Important methods of cooking are the following: (1) Boiling in water (2) Steaming (3) Baking (4) Roasting and (5) Frying.

Effect of cooking on the various nutrients

Carbohydrates: Cooking is essential for proper digestion of starch which is an important source of calories in the diet. When heat is applied in any method of cooking, the

starch granules swell up and burst and become gelatinised in which state they are almost completely digested and absorbed. Raw starch as such (uncooked flour, potato etc.) is enclosed in starch granules which are resistant to the human digestive juices.

Fat: Cooking under ordinary household conditions has very little effect on fats but there is some evidence to show that on prolonged heating (*e.g.* when used for frying over a number of days) fats become slightly toxic as revealed by animal experiments.

Proteins: Application of heat to proteins causes coagulation and shrinking. Moderately cooked protein is more easily digested than raw protein. But excessive exposure to heat as in roasting will eventually reduce appreciably the nutritive value of proteins. *Certain foods like pulses show marked improvement in nutritive value as a result of heat treatment.* They contain substances which hinder digestion of proteins by the enzyme trypsin. These substances (trypsin inhibitors) are destroyed by heat during cooking, thus bringing about an improvement in the nutritive value of the proteins.

VITAMINS:

Vitamins A & D: As they are insoluble in water, no loss occurs by the discarding of cooking water. There is only slight destruction of vitamin A and carotene when vegetables are cooked in water; but on frying or roasting, considerable loss occurs.

Thiamine (*Vitamin* B_1): Loss of vitamin B_1 in foods occurs in two ways: (*a*) its destruction during cooking (*b*) its dissolution in the cooking water. Hence the amount destroyed during cooking varies. Discarding the cooking water accounts for a loss of nearly 20-50%, depending on the quantity of water used in cooking. If soda is added to dhal during cooking, most of the vitamin is destroyed.

So cooking soda should not be added to pulses and dhals for improving their cooking quality.

Ascorbic acid (*Vitamin C*) : The loss of vitamin C during cooking of vegetables is mainly due to oxidation and this is accelerated by exposure to air. High acidity prevents loss to a certain extent. Discarding the cooking water accounts for a considerable amount of loss of vitamin C. Contamination with copper also accelerates the destruction of vitamin C. The quantity of vitamin C lost from vegetables during cooking may vary from 10 to 60 per cent of the quantity present in the food, depending on the vegetable cooked and the method of cooking.

MINERALS :

Calcium and phosphorus : Cooking does not affect the calcium and phosphorus contents except when the cooking water is discarded. When vegetables are cooked in "hard" water, appreciable amounts of calcium present in the water may become incorporated in them.

Iron : There is practically no loss of iron during cooking of foods except when the cooked water is discarded. In general, cooking tends to increase the ease with which the body can absorb iron from foods. Further, dietary iron may be increased due to amounts picked up from iron knives used for slicing vegetables and from cast iron pans commonly used for roasting them.

XVIII. REQUIREMENTS OF DIETARY ESSENTIALS

For maintaining proper health and physical efficiency, the diet should contain sufficient amounts of all nutrients. For designing balanced diets, we should know the daily requirements of the different dietary essentials. The figures given in Table 24 are based on the standards

	Calories	Protein (g)	Calcium (g)	Iron (mg)	Vitamin A (I.U.)	Thiamine (mg)	Riboflavin (mg)	Nicotinic acid (mg)	Vitamin C (mg)	Vitamin D* (I.U.)
Man (55 kg or 120 lbs)										
Light work	2400	70	0·8	15	5000	1·2	1·4	12	50	...
Moderate work	3000	70	0·8	15	5000	1·5	1·6	14	50	...
Hard work	3500	70	0·8	15	5000	1·7	1·8	16	50	...
Very hard work	3800	70	0·8	15	5000	1·9	2·0	18	50	...
Woman (45 Kg or 100 lbs)										
Light work	2100	65	0·8	20	5000	1·0	1·2	10	50	...
Moderate work	2500	65	0·8	20	5000	1·2	1·4	12	50	...
Hard work	3000	65	0·8	20	5000	1·5	1·7	14	50	...
Pregnancy	2100	90	1·5	30	6000	1·5	1·7	14	60	400
Lactation	2700	100	1·5	25	8000	1·8	2·0	14	70	400
Children										
1–2 Yrs	1000	35	0·7	8	2000	0·6	0·7	6	30	400
3–4 ,,	1100	40	0·8	9	2200	0·7	0·8	7	35	400
5–6 ,,	1200	45	0·8	10	2500	0·7	0·8	8	45	400
7–8 ,,	1400	50	0·9	12	3500	0·8	0·9	9	40	400
9–10 ,,	1700	60	1·0	12	4000	1·0	1·1	10	50	400
11–12 ,,	2000	70	1·0	15	5000	1·2	1·4	15	50	400
Adolescents										
13–16 Yrs. Boys	2500	80	1·0	20	5000	1·5	1·6	15	50	400
,, Girls	2400	75	1·0	20	5000	1·3	1·4	13	50	400
17–20 Yrs. Boys	3000	85	1·0	20	5000	1·8	1·9	18	50	400
,, Girls	2500	80	1·0	20	5000	1·4	1·5	14	50	400

* See page 60 regarding effect of sun light on vitamin D requirements.

suggested by the Nutrition Advisory Committee, I.C.M.R., India and the Food and Nutrition Board of the National Research Council, U.S.A. These figures represent the *optimum* requirements for individuals of varying age, physical activity and physiological state.

(1) Energy

The term 'net calorie' means the energy available from the food actually consumed. Additional calories for moderate and hard work, provided according to the recommendations of the Technical Commission on Nutrition of the League of Nations Health Organisation, are given below:

Light work: Up to 75 calories per adult per hour of work.

Moderate work: 75-150 calories per hour of work.

Hard work: 150-300 calories per hour of work.

Very hard work: 300 calories and upwards per hour of work.

Examples of different types of activities are given below:

Light work: Writing, typing, tailoring.

Moderate work: Walking, shoemaking, carpentry, light engineering work.

Hard work: Cycling, heavy carpentry, light blacksmithing, stonemason's work, ploughing, sawing wood, harvesting.

Very hard work: Coal mining, heavy blacksmithing, earth work, carrying heavy loads, woodcutting.

Protein

Animal proteins, in general, possess a higher nutritive value than vegetable proteins. Combinations of cereal, pulse and oilseed proteins possess a high nutritive value.

The protein requirements of adults can be met by a mixture of cereal, oilseed and pulse proteins. For children and pregnant women, however, about 25-50% of the dietary protein should be derived from milk and other animal foods. *Milk is by far the best source of animal protein, as it supplies besides protein, other dietary essentials like calcium, vitamin A and vitamin B-complex.*

Fat

No standards for the requirements of fat are available. The following approximate fat requirements may be useful in formulating balanced diets:

Adults	...	15–25% of total calories in the diet from fat.
Children	...	20–30% of total calories in the diet from fat.
Infants	...	30-40% of total calories in the diet from fat.

Calcium

The figures given in Table 24 show *that the calcium requirements of children are equal to or higher than that of adults.* Hence the diet of children should include larger amounts of foods rich in calcium such as milk, ragi, green leafy vegetables etc. than that of adults.

Phosphorus

The requirement of phosphorus is closely related to that of calcium. It is generally agreed that the phosphorus requirement is about 20% higher than that of calcium. A large part of the phosphorus present in cereals, pulses and nuts is in the form of *phytin.* Only 40-60% of *phytin phosphorus* is available to the human body. Further, *phytin phosphorus* interferes with the absorption of dietary calcium. On the other hand, the phosphorus present in milk is well utilised by human beings. It is for this reason that the diets of children should include large amounts of milk which is rich in available calcium and phosphorus.

Iron

The daily requirements range from 6-30 mg. depending on age and the physiological state of the individual. Women require more iron than men. Iron requirement of women is further increased during pregnancy and lactation. Iron present in foods of vegetable origin is not well utilised by human beings as compared to that present in animal foods.

Other elements

Besides, calcium, phosphorus and iron, a large number of other elements are also required. These are sodium, potassium, magnesium, manganese, copper, cobalt, zinc, iodine etc. Well-balanced diets of the type given in Tables 31-35 will provide adequate amounts of the above elements.

Vitamin A

The average diets contain both preformed vitamin A and carotene. While vitamin A is almost completely absorbed from the diet, carotene is less well absorbed. The absorption of carotene ranges from 20–50%, depending on the fat content of the diet. Since the major portion of the vitamin A activity in Indian diets is contributed by carotene, a high allowance of 5000 I. U. has been suggested for adults. Vitamin A requirements are increased during pregnancy and lactation. The diet of young children should contain some preformed vitamin A from milk, butter, ghee and fish liver oils.

Vitamin B_1

Vitamin B_1 requirements range from 0.4 to 1.8 mg. depending on age and physical activity. The quantity of vitamin B_1 required varies with the energy requirements, as this vitamin is concerned in carbohydrate

metabolism. The optimum level of vitamin B_1 per 1000 calories has been suggested as 0.4-0.5 mg. Whole cereals oilseeds, nuts and pulses are the most important sources of vitamin B_1 in the diets of children and adults, while milk is the main source of vitamin B_1 in the diet of infants.

Riboflavin

As in the case of vitamin B_1, the amount required is proportional to the calorie intake. The requirements of riboflavin vary from 0.6 to 2.0 mg. depending on age and physical activity. The optimum level of riboflavin in the diet per 1000 calories has been suggested as 0.6—0.7 mg. Milk, liver, and eggs are the richest sources of riboflavin. Cereals, pulses and green leafy vegetables are important sources of riboflavin in the diets of older children and adults in India, while milk is an important source in the diet of infants and young children.

The average Indian diet is deficient in riboflavin. This can be made up by the incorporation of half to one ounce of Indian multipurpose food (Chapter XI) in the diet.

Nicotinic acid

The nicotinic acid requirements vary from 4 to 18 mg. depending on age and physical activity. As in the case of vitamin B_1 and riboflavin, the nicotinic acid requirement is proportional to the calorie intake. The optimum quantity of nicotinic acid in the diet per 1000 calories has been suggested as 4-5 mg. Cereals are the most important source of nicotinic acid in average Indian diets.

Vitamin C

The average requirements of vitamin C range from 20-70 mg. depending on age and physiological state. The requirements can be readily met by the inclusion of leafy

vegetables and cheap fruits *e.g. amla*, and guava in the diet.

Vitamin D

The body obtains vitamin D from two sources: (1) food and (2) sun light. The requirements of vitamin D in temperate climates are 400 international units for adults and children. Since exposure to sun light produces vitamin D in the body, persons living in tropical countries may derive considerable amount of vitamin D from this source and may need only about 200 units from food.

Other vitamins

Balanced diets given in Tables 31-35 will provide adequate amounts of all other vitamins.

XIX. FEEDING OF NORMAL INFANTS

Human milk is universally regarded as the ideal food for the feeding of infants during the early months. Yet, owing to various causes, an infant may not derive adequate nutrition from the mother and feeding with mammalian milk may be necessary. Cow's milk is commonly used in different countries for the feeding of infants and children. In India, in addition to cow's milk, buffalo milk is also used to some extent in certain provinces. The milk of each species differs from that of others in the relative amounts of proximate principles, mineral constituents, vitamins and also in physical properties and digestibility. The use of processed milk foods in the feeding of infants is also on the increase in different parts of the world. For the successful feeding of infants with cow's or buffalo milk, a knowledge of the nutritional requirements and the digestive capacity of the infant is necessary. The present

section deals with the problems involved in the artificial feeding of infants with fresh mammalian milk and with processed infant foods.

Nutritional requirements of infants

The nutritional requirements of infants up to one year are given in Table 25. The milk used should meet the essential requirements for the nourishment of the child. Besides providing the requirements of proteins, fats, carbohydrates, minerals and vitamins, the feed should be free from harmful bacteria and should be readily digestible.

Table 25. **Dietary requirements of Infants** (infant/day.)

Age (months)	Calories	Protein (g)	Calcium (g)	Iron (mg)
1–3	100/kg.	3·5/kg.	0·3	3
4–9	100/kg.	3·5/kg.	0·5	4
10–12	100/kg.	3·5/kg.	0·6	6

Age (months)	Vitamin A (I.U.)	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)	Ascorbic acid (mg)	Vitamin D (I.U.)
1–3	1500	0·2	0·3	3	10	400
4–9	1500	0·3	0·5	4	15	400
10–12	1500	0·4	0·6	5	20	400

Cow and buffalo milk formulae

The nutritional requirements of normal infants may be met by the use of simple mixtures of whole boiled cow's milk or partially skimmed or toned buffalo milk, sugar and water, together with food supplements containing vitamin D, ascorbic acid, and iron.

The chemical composition of human, cow's and buffalo milk is given in Table 36. Whole buffalo milk is rich in fat and hence is not suitable for feeding infants. It should be partially skimmed or *toned. Toned buffalo milk can be readily prepared in the home by mixing equal quantities of pure buffalo milk and milk reconstituted from skimmed milk powder.* Infants vary much in their ability to digest undiluted boiled milk. Dilution of the milk serves to make it more readily digestible and, at the same time, permits a more generous fluid intake. Dilution is required only for the young infant. Undiluted boiled milk usually can be digested without difficulty at seven or eight months of age. The quantities of milk, water and sugar required for infants of age varying from 1 to 12 months are given in Table 26. In addition to this, the infant up to the age of 6 months requires a supplement of fruit juice (preferably orange or tomato juice) as a source of vitamin C and shark liver oil as a source of vitmins A & D. For infants older than 6 months, small amounts of cooked and mashed green leafy vegetables, cereals and fruit pulp should be introduced in gradually increasing amounts as shown in Table 26. When both cow's and buffalo milks are not available, vegetable milk prepared from soya bean according to the method given in Chapter IX, can be used for infants aged above six months.

Processed Infant foods

Whole milk powder prepared from cow's milk contains about 26% protein and 26% fat. Infant foods available

Table 26. **Feeding of infants from 1 to 12 months**

(Requirements per day)

Age (months)	Approx. body weight (kilogram)	Cow's[1] milk or partially skimmed buffalo milk (ozs.)	Water (ozs.)	Sugar (ozs.)	Number of feeds per day	Fruit[2] juice (ozs.)	Shark[3] liver oil (teaspoon)	Fruit[4] and vegetable pulp (ozs.)	Cereals[5] (ozs.)
1	3.0	10	5	½	6	1	¼	...	...
2	3.5	12	6	½	6	1	¼	...	...
3	4.0	14	7	¾	6	1	¼	...	...
4–5	4.5–5.0	16–18	8	1	5	1½	½	...	...
6–7	5.5–6.0	20–22	8	1¼	5	2	¾	½	...
8–9	6.5–7.0	24	8	1½	5	2	1	1	½
10–11	7.5–8.0	26	8	1¾	5	3	1	1½	1
12	8.5	28	8	2	5	3	1	1½	1½

[1] If the infant is receiving breast milk, the quantity of cows' milk and the number of feeds should be reduced.

[2] Orange or tomato juice may be given as a source of vitamin C.

[3] Shark liver oil supplies vitamins A and D.

[4] Fruit pulp prepared from ripe banana, mango and papaya and pulps prepared from tender cooked leafy vegetables may be given.

[5] Bread or cereal flour cooked in the form of porridge or pudding with milk and sugar may be given.

on the market have widely varying protein (14 to 27%) and fat (10-25%) contents. They may be grouped broadly as follows: (1) *Whole milk food* (Full cream milk powder) with added vitamin D and iron (2) *Half cream milk food* with added vitamin D and iron and (3) *Humanised milk food* with added carbohydrates and the proportion of protein altered more or less to resemble those of human milk. In view of the fact that the protein and fat requirements of infants under tropical conditions are somewhat lower than the standards suggested for infants in temperate climates, an infant food with a protein content of 20-22 per cent and fat content of 14 per cent may be more suited for infants in tropical countries. Recently a process for the preparation of infant food in India has been standardised at the Central Food Technological Research Institute,

Mysore. An infant food ('Amul infant food'), prepared according to the above formula, will be shortly manufactured and marketed by the Kaira Co-operative Milk Producers Union, Anand. The chemical composition of some common proprietary infant foods as compared with 'Amul infant food' is given in Table 27.

Table 27. **The composition of some proprietary infant foods**[1]

Product	Fat%	Protein%	Carbohydrate%	Mineral salts%	Moisture%	Description
Amul infant food[2]	14·5	21·5	56·4	4·8	2·8	A milk food with reduced fat.
Cow and Gate Full cream food[3]	27·3	26·6	37·6	6·0	2·5	A standardised unmodified milk food suitable for feeding normal infants up to 9 months.
Cow and Gate Half cream food	15·0	20·0	58·0	4·5	2·5	A milk food with reduced fat for infants up to 3 months and older fat intolerant infants.
Glaxo	26·5	24·9	38·5	5·6	2·9	Dried milk food (unmodified).
Lactogen	25·0	16·2	53·3	3·5	3·5	Dried milk modified by the addition of lactose.

[1] W. C. Harvey and H. Hill (1948), *Milk Products*, Second Edition, p. 321 H. K. Lewis and Co. Ltd., London.

[2] Prepared according to the formula developed by C.F.T.R.I., at the factory of the Kaira Co-operative Milk Producers Union Ltd., Anand. Chandrasekhara, M. R., Swaminathan, M., Bhatia, D. S. and Subrahmanyan, V., 1957, *Indian Dairyman, IX*, 276.

[3] The composition of many common proprietary infant foods is given in *Hutchinson's Food and the Principles of Dietetics*, revised by V.H. Mottram and G. Graham, 1948, Tenth Edition, p. 560, Edwin Arnold & Co., London.

The main advantages of dried milk foods over fluid milk are: (*a*) the ready availability of the product (*b*) the ease of transportation (*c*) the dependability of the hygienic and nutritional quality of the product (*d*) the long keeping quality and (*e*) the unvarying chemical composition and freedom from adulteration. Most of the infant foods are fortified with vitamin D and some, also with iron. They do not, however, contain sufficient vitamin C. *So artificially fed babies require a supplement of vitamin C.* For feeding infants, the proprietary infant foods are usually reconstituted with 8 to 10 times their weight of hot water depending on the age of the infant.

XX. FEEDING OF WEANED INFANTS AND YOUNG CHILDREN

Infants are generally weaned in India at the age of about 9 to 12 months. The infants belonging to the low income groups of the population are generally fed after weaning on cooked cereals and cereal gruels. These by themselves do not supply sufficient proteins, minerals and vitamins. Sufficient amounts of milk and protein-rich supplementary foods are not normally included in the diet. Milk is the ideal food supplement to the diet of weaned infants. When milk is not available in adequate amounts, the deficiencies in the diet can be made up by including sufficient quantities of split pulses, vegetable milk and curds prepared from groundnut or soya bean, nutritionally balanced malt food or Indian multipurpose food. A number of feeding experiments conducted in different parts of the world have demonstrated that it is possible to prepare an adequate diet for weaned infants and young children based on cereals, pulses, nuts and oilseeds and vegetables, when sufficient quantity of

milk is not available. Balanced diets, at moderate costs, for the feeding of weaned infants are given in Table 28.

Table 28. **Balanced diets for weaned infants and young children (1-2 years)**

Foodstuff	Diet I (ounces)[1]	Diet II (ounces)	Diet III (ounces)	Diet IV (ounces)
Cereals (rice, wheat, ragi[2])	2–3	2–3	2–3	2–3
Puffed Bengal gram flour	1	1	2	2
Milk and curds ...	20	5	5	5
Egg	1	...	...	...
Groundnut milk curd[3] ...	...	10	10	10
Indian multipurpose food[5]	...	1	1	...
Nutritionally balanced malt food[4]	...	1	...	2
Green leafy vegetables ...	1	1	1	1
Roots and tubers and other vegetables ...	1	1	1	1
Fresh fruits	2	2	2	2
Sugar and jaggery ...	2	2	2	2

[1] One ounce = 28·4 grams.
[2] Ragi may be given in the form of ragi malt flour.
[3] See chapter IX.
[4] „ „ X.
[5] „ „ XI.

Since the capacity of infants to digest coarse food is limited, the food preparations must be well cooked and free from fibrous material. The role of different foods in the diet of weaned infants is described below:

Cereals and pulses

The feeding of cereal as the baby's first solid food has been a custom for many centuries. Many pediatricians are convinced that the cereal adds something of importance to the diet and babies who receive it along with a milk diet thrive better than those who do not. The cereal and pulse flours can be mixed and made into "Idli", pudding

or thick porridge and given to the infant after the addition of sugar or salt. Investigations carried out at the Nutrition Research Laboratories, Coonoor (now at Hyderabad) have shown that puffed Bengal gram dhal flour is a good supplement to the diet of young children.

Vegetables

Vegetables, particularly the green leafy vegetables, supplement the infant's diet moderately in various nutritional essentials, including iron, carotene and vitamin C. The vegetables, after being cooked, should be finely divided by mashing and then fed. Many of the commonly used green leafy vegetables, carrot, tender beans and green peas may be used singly or in combination. In western countries, many ready-to-serve vegetable preparations are available in cans. Though these are convenient for feeding babies, they are costly and hence beyond the means of the poor people. In starting the feeding of mashed vegetables, a small amount is given at first, say two teaspoonfuls and the amount is gradually increased to about one ounce per day as the infant grows. After the age of one year, the baby should receive daily some quantity of cooked and mashed green leafy vegetables. In addition to the supply of nutrients, vegetables contain small amounts of cellulose materials which help in the normal bowel movements of the infants.

Fruits

Fruits belong to the class of protective foods as they are rich sources of vitamin C. Further the citric acid and its salts present in fruit juices may help in the absorption of calcium. Fruits contain fair amounts of easily assimilable forms of sugars and appreciable quantities of essential minerals. Fruits, in addition to their nutritive value, may also serve to stimulate the appetite

and aid in the digestion of milk and other protein foods. They may also exert a beneficial effect on the intestinal microflora, thereby aiding in the absorption of nutrients. Fruit juice and fruit juice concentrates are widely given to infants even from the age of 5 months. Orange and tomato juices are the most popular for this purpose. The addition of fruits and fruit juices to the diet relatively early in infancy is desirable. Fruits commonly used are banana, mango, papaya, tomato and orange. In starting the feeding of fruits, the fruit pulp should be given in small amounts from the 8th month onwards and the quantity gradually increased as the infant grows. Certain fruits like ripe banana and mashed cooked apples are being extensively used in the treatment of diarrhoea in children.

XXI. BALANCED DIETS FOR CHILDREN, ADULTS AND INDUSTRIAL AND AGRICULTURAL WORKERS

A balanced diet is one which contains the various foodstuffs, such as energy yielding foods, body building foods and protective foods, in the correct proportions so that an individual is assured of obtaining the minimum daily requirements of all the nutrients. The components of a balanced diet will naturally differ according to age, sex and the physiological state *viz.*, pregnancy, lactation etc. The minimum requirements of dietary essentials for different age groups are given in Table 24. An ill-balanced diet does not provide the minimum daily requirements of the various nutrients and hence an individual taking such a diet is apt to suffer from various degrees of malnutrition or deficiency diseases and his physical efficiency will also be very low.

Table 29 shows balanced diets for a moderately hard-working adult and a child 3 years old as compared with ill-balanced diets ordinarily consumed by the poorer sections of the population.

Table 29. **Balanced and Ill-balanced diets**

Foodstuff	Adult		Child (3 years)	
	Ill-balanced diet (oz)	Balanced diet (oz)	Ill-balanced diet (oz)	Balanced diet (oz)
Cereals ...	20	14	6	3
Ragi, malted ...	...	...	...	1
Pulses ...	1	3	0·5	1
Groundnut, roasted ...	...	1	...	...
Green leafy vegetables ...	...	4	...	1
Roots and tubers (Potato, sweet potato, radish) ...	2	3	1	1
Non-leafy vegetables (Brinjal, green plantain etc.) ...	2	3	1	...
Sugar and jaggery ...	2	2	1·5	1·5
Vegetable oils and fats ...	0·5	2	0·5	0·5
Milk ...	3	10	5	15
Meat and fish ...	...	2	...	...
Eggs ...	...	1	...	1
Fruits (tomato, guava, *amla* etc.) ...	...	3	...	2

The nutritive value of the balanced and ill-balanced diets as compared with the daily dietary requirements is given in Table 30. It will be noted that:

(1) The ill-balanced diets lack in protective and protein-rich foods and hence are deficient in proteins, vitamin A, riboflavin, vitamin B_{12} and calcium.

(2) The balanced diets contain adequate quantities of protein-rich and protective foods and provide the minimum daily requirement of all the food factors.

(3) The diet of a child should contain more of protective foods and less of energy yielding foods than that of an adult.

Table 30. **Nutritive value of ill-balanced and balanced diets as compared with the daily requirements**

Nutrients	Adult			Child (3 years)		
	Daily requirements	Ill-balanced diet	Balanced diet	Daily requirements	Ill-balanced diet	Balanced diet
Calories	3,000	3,000	3,300	1,000	963	1,117
Protein (g)	70	**46**	76	35	**18.6**	36·5
Fat (g)	50–60	62	85	20–40	20.4	38·4
Calcium (g)	1·0	**0.35**	1·14	0·7	**0.30**	0·78
Phosphorus (g) ...	1·2	0·78	1·62	0·7	0·36	0·78
Iron (mg)	20–30	9·8	38	8	8·7	11·4
Vitamin A (I.U.) ...	5,000	**1,200**	5,600	2,000	**407**	2,357
Thiamine (mg) ...	1·2	0·8	1·5	0·6	0·33	0·71
Riboflavin (mg) ...	1·0	**0.4**	1·0	0·7	**0.31**	1·02
Nicotinic acid (mg) ...	15·0	12·0	20·0	6·0	3·4	4·3
Vitamin C (mg) ...	50	**12**	68	30	**12**	39

Balanced diets for men

When recommending balanced diets for men, the degree of activity has to be borne in mind. A sedentary or light worker needs less calories than a moderately hard worker and a very hard worker needs much more than the former two. Balanced diets, at moderate costs, for men of varying degrees of activities are given in Table 31.

Balanced diets for women

In the case of women, in addition to the degree of physical activity, other physiological factors such as pregnancy and lactation have also to be taken into consideration. An expectant mother needs more proteins, calcium,

Table 31. **Balanced diets for men**

* (Ounces per day)

Foodstuff	Light work		Moderate work		Very hard work	
	V	NV	V	NV	V	NV
Cereals[1] (Rice, wheat or millets)	14	14	16	16	20	20
Pulses[3]	3	2	3	2	3	2
Groundnut, roasted ...	1	1	2	1	3	2
Bengal gram, puffed ...	1	...	1	...	1	...
Milk and curds[2, 4] ...	10	5	10	5	10	5
Meat and fish	...	3	...	3	...	3
Eggs	...	One	...	One	...	One
Green leafy vegetables ...	3	3	3	3	3	3
Roots and tubers	4	4	4	4	4	4
Other vegetables	2	2	2	2	2	2
Fruits	2	2	2	2	2	2
Oils and fats	1	1	2	2	2	2
Sugar and jaggery ...	2	2	2	2	2	2

* One ounce = 28.4g. V = Vegetarian NV = Non-Vegetarian

[1] If sufficient quantities of cereals are not available, tapioca flour can be used to the extent of 3 to 4 ounces per day. Cereals should include 4 ounces of ragi, a millet rich in calcium.

[2] Vegetable milk and curds prepared at home according to the process given in Chapter IX can be used in place of curds from cow's or buffalo milk.

[3] One ounce of Indian multipurpose food (Chapter XI) incorporated in the diet in place of one ounce of groundnut or pulses will provide extra amounts of protein, calcium and certain vitamins.

[4] Consumption of milk and other protective foods to a greater extent is desirable.

iron and vitamins, especially during the second half of pregnancy. A nursing mother needs more of all the nutrients than a normal woman as she has to feed the baby. Hence diets have to be modified according to their

needs. Balanced diets at moderate costs for women are given in Table 32.

Table 32. **Balanced diets for women**

* (Ounces per day)

Foodstuff	Light work		Moderate work		Very hard work		Expectant mother		Nursing mother	
	V	NV	V	NV	V	NV	V	NV	V	NV
Cereals[1]	11	11	14	14	16	16	10	10	15	15
Pulses[3]	3	2	3	2	3	2	4	2	4	2
Groundnut, roasted	1	1	2	1	2	1	1	1	2	1
Gingelly seeds ...	...	...	...	...	...	...	1	1	1	1
Bengal gram, puffed	1	...	1	...	1	...	2	1	2	1
Milk and curds[2,4] ...	10	5	10	5	10	5	20	12	20	12
Meat and fish ...	...	2	...	2	...	2	...	3	...	3
Eggs	...	1	...	1	...	1	...	1	...	1
Green leafy vegetables ...	3	3	3	3	3	3	4	4	4	4
Roots and tubers ...	4	4	4	4	4	4	2	2	2	2
Other vegetables ...	2	2	2	2	2	2	2	2	2	2
Fruits	2	2	2	2	2	2	4	4	4	4
Oils and fats ...	1	1	1	1	1	1	1	1	1	1
Sugar and jaggery ...	2	2	2	2	2	2	2	2	2	2

* One ounce = 28·4g. V = Vegetarian NV = Non-Vegetarian

[1] Cereals should include 3 to 4 ozs. of ragi, a millet rich in calcium

[2] If sufficient milk is not available, vegetable milk and curds prepared according to directions given in Chap. IX may be consumed with advantage.

[3] Incorporation of one ounce of Indian multipurpose food (Chap XI) in the diet in place of one ounce of groundnut or pulse will provide extra amounts of protein, calcium and certain vitamins.

[4] Consumption of milk and other protective foods to a greater extent is desirable.

Balanced diets for children and adolescents

Since children and adolescents are continuously growing their needs for nutrients increase as they grow. Hence

the diet of children should contain greater amounts of protective foods than energy yielding foods. Balanced diets at moderate costs for children and adolescents are given in Tables 33 and 34.

Table 33. **Balanced diets for children**

(ounces[1] per day)

Foodstuff	3 to 4 years		5 to 6 years		7 to 8 years		9 to 10 years		11 to 12 years	
	V	NV	V	NV	V	NV	V	NV	V	NV
Cereals[2] ...	5	5	7	7	9	9	11	11	12	12
Pulses[6] ...	1	1	1·5	1·5	2	2	2	2	2	2
Groundnut, roasted ...	...	...	1	...	1	1	2	1	2	1
Gingelly seeds ...	0·5	0·5	0·5	0·5	1	1	1	1	1	1
Bengal gram, puffed ...	1	...	1	...	1	...	2	...	2	1
Milk and curds[3],[5]	20	12	15	8	15	8	15	8	15	8
Meat and fish ...	...	1	...	2	...	2	...	2	...	2
Eggs ...	...	1	...	1	...	1	...	1	...	1
Green leafy vegetables ...	1·5	1·5	2	2	3	3	3	3	3	3
Roots and tubers and other vegetables ...	1	1	1	1	2	2	4	4	5	5
Fruits ...	3	3	3	3	3	3	3	3	3	3
Oils and fats[4] ...	0·5	0·5	0·5	0·5	0·5	0·5	1	1	1	1
Sugar and jaggery ...	2	2	2	2	2	2	2	2	2	2

V = Vegetarian NV = Non-Vegetarian

[1] One ounce = 28·4 g.

[2] Cereals should include 1-2 ounces of ragi malt for children aged 3–6 years and 3–4 ounces of ragi for children aged 7-12 years.

[3] If sufficient milk is not available, vegetable milk and curds prepared according to the method given in Chapter IX can be given along with one teaspoonful of shark liver oil daily.

[4] Half the quantity as butter and ghee.

[5] Consumption of milk and other protective foods to a greater extent is desirable.

[6] Consumption of half to one ounce of Indian multipurpose food in place of an equal quantity of pulses will provide extra amounts of protein, calcium and certain vitamins.

Table 34. **Balanced diets for adolescent boys and girls**
(ounces per day)

Foodstuff	Boys				Girls			
	13 to 16 years		17 to 21 years		13 to 16 years		17 to 21 years	
	V	NV	V	NV	V	NV	V	NV
Cereals[1] ...	15	15	18	18	14	14	15	15
Pulses[2] ...	3	2	3	2	3	2	3	2
Groundnut, roasted ...	2	1	2	1	2	1	2	1
Bengal gram, puffed ...	1	...	1	...	1	...	1	...
Milk and curds[3] ...	10	5	10	5	10	5	10	5
Meat and fish ...	...	2	...	2	...	2	...	2
Eggs ...	...	1	...	1	...	1	...	1
Green leafy vegetables ...	4	4	4	4	4	4	4	4
Roots and tubers ...	4	4	4	4	4	4	4	4
Other vegetables ...	4	4	4	4	4	4	4	4
Fruits ...	4	4	4	4	4	4	4	4
Oils and fats ...	2	2	2	2	2	2	2	2
Sugar and jaggery ...	2	2	2	2	2	2	2	2

V=Vegetarian NV=Non-Vegetarian

[1] Cereals should include 4 ounces of ragi, a millet rich in calcium.
[2] Consumption of one ounce of Indian multipurpose food in place of one ounce of pulse is desirable.
[3] When milk and curds are not available, vegetable milk and curds prepared according to the method given in Chapter IX can be used with considerable benefit.

Diets for Industrial and Agricultural Workers

The problem of providing a balanced diet for industrial and agricultural workers *at low cost* has been engaging the attention of nutrition workers in different countries. In view of their scarcity and high cost, protective and protein-rich foods such as milk, eggs, meat, fish and fruits cannot be included in adequate amounts in the diet of the low income groups. The diet should therefore include

liberal amounts of pulses, groundnut and green leafy vegetables. Balanced diets suitable for industrial and agricultural workers are given in Table 35.

Supplementary foods

Consumption of one ounce of multipurpose food (Chap. XI) in place of one ounce of pulse or groundnut will provide extra amounts of protein, calcium, riboflavin and vitamin A.

Table 35. **Balanced diets for industrial and agricultural workers** (ounces per day)

Foodstuff	Men				Women			
	Light work	Moderate work	Hard work	Very hard work	Light work	Moderate work	Hard work	Moderate work (Nursing mothers)
Rice or wheat[1] ...	8	9	10	11	7	8	9	9
Millets[2] ...	8	9	10	11	7	8	9	9
Pulses ...	2	2	2	2	2	2	2	2
Groundnut (roasted) ...	1	1	1	2	1	1	1	2
Bengal gram, (puffed) ...	1	1	1	1	1	1	1	2
Green leafy vegetables ...	4	4	4	4	4	4	4	4
Roots and tubers and other vegetables ...	8	8	8	8	8	8	8	8
Oils and fats ...	1	1	1	1	1	1	1	1
Sugar and jaggery ...	1	1	1	1	1	1	1	1
Milk and curds[3] ...	4	4	4	4	4	4	4	4
Meat or fish ...	1	1	1	1	1	1	1	1
Indian multipurpose food ...	1	1	1	1	1	1	1	1

[1] Four ounces of cereals can be replaced by 4 ounces of tapioca flour or a blend of tapioca flour (75 parts) and groundnut flour (25 parts) if sufficient quantity of cereals is not available.

[2] Millets should include 4 ounces of ragi.

[3] When milk and curds are not available, vegetable milk and curds prepared according to the method given in Chapter IX can be used with benefit.

Table 36. **Table of**

Name of foodstuff	Moisture %	Protein %	Fat %	Mineral matter %	Fibre %	Carbohydrate %
Cereals						
1 Bajra or cambu	12.4	11.6	5.0	2.7	1.2	67.
2 Barley	12.5	11.5	1.3	1.5	3.9	69.
3 Cholam	11.9	10.4	1.9	1.8	3.2	70.
4 Maize, dry, yellow	14.9	11.1	3.6	1.5	2.7	66.
5 Oatmeal	10.7	13.6	7.6	1.8	3.5	62.
6 Ragi	13.1	7.1	1.3	2.2	3.3	73.
7 Rice, parboiled, milled ...	13.5	7.1	0.7	0.8	0.2	77.
8 Rice, raw, milled[2]	12.2	7.0	0.5	0.7	0.2	79.
9 Wheat, whole[3]	12.8	11.8	1.5	1.5	1.2	71.
10 Italian millet	11.2	12.3	4.7	3.2	8.0	60.
11 Samai	11.5	7.7	4.7	4.8	7.6	63.
12 Varagu or kodu millet ...	12.8	8.3	1.4	2.9	9.0	65.
Pulses						
13 Bengal gram	9.8	17.1	5.3	2.7	3.9	61.
14 Bengal gram dhal	11.2	22.5	5.2	2.2	...	58.
15 Black gram dhal	10.9	24.0	1.4	3.4	...	60.
16 Cow gram	12.0	24.6	0.7	3.2	3.8	55.
17 Field bean, dry	9.6	24.9	0.8	3.2	1.4	60.
18 Green gram dhal	10.4	24.0	1.3	3.6	...	60.
19 Red gram dhal	12.2	22.3	1.7	3.6	...	60.
20 Soya bean	8.1	43.2	19.5	4.6	3.7	20.
Nuts and oilseeds						
21 Almond	5.2	20.8	58.9	2.9	1.7	10.
22 Cashew nut	5.9	21.2	46.9	2.4	1.3	22.
23 Cocoanut	36.3	4.5	41.6	1.0	3.6	13.
24 Gingelly (Sesame) seeds ...	5.1	18.3	43.3	5.2	2.9	25.
25 Groundnut	7.9	26.7	40.1	1.9	3.1	20.
Leafy vegetables						
26 Amaranth, tender	85.8	4.9	0.5	3.1	...	5.

[1] For botanical and other Indian names of the foodstuffs and th nutritive value of other foodstuffs, reference may be made to Health Bulleti No. 23 published by the Government of India.

Food Values[1]

Calcium (Ca) %	Phosphorus (P) %	Iron (Fe) mg. %	Calorific value per 100 g.	Vitamin A value, (I.U. per 100 g.)	Vitamin B_1 (mg. per 100 g.)	Nicotinic acid (mg. per 100 g.)	Riboflavin (mg. per 100 g.)	Vitamin C (mg. per 100 g.)
0.05	0.35	8.8	360	85	0.33	2.3	0.14	0
0.03	0.23	3.7	335	110	0.45	4.7	0.12	0
0.03	0.28	6.2	341	136	0.35	1.8	0.16	0
0.01	0.33	2.1	342	560	0.42	1.2	0.14	0
0.05	0.38	3.8	374	...	0.54	1.1	0.12	0
0.33	0.27	5.4	332	70	0.42	1.1	0.12	0
0.01	0.17	3.2	346	0	0.22	2.4	0.05	0
0.01	0.11	2.8	348	0	0.11	1.0	0.03	0
0.05	0.32	5.3	348	108	0.54	5.0	0.12	0
0.03	0.29	6.3	334	54	0.59	1.8	0.12	0
0.02	0.36	7.1	328	...	0.33	1.2	0.11	0
0.04	0.24	5.2	308	...	0.33	1.4	0.12	0
0.19	0.24	9.8	361	120	0.45	2.6	0.21	5.0
0.07	0.31	8.9	372	110	0.46	2.8	0.24	...
0.20	0.37	9.8	350	64	0.45	2.0	0.22	...
0.07	0.49	3.8	327	60	0.50	1.5	0.21	...
0.06	0.45	2.0	347	...	0.52	1.8	0.21	...
0.14	0.28	8.4	350	158	0.46	2.0	0.26	...
0.14	0.26	8.8	345	220	0.45	2.4	0.22	...
0.24	0.69	11.3	432	310	0.73	2.4	0.32	...
0.23	0.49	3.5	655	...	0.44	2.5	0.12	0
0.05	0.45	5.0	596	100	0.63	2.1	0.19	0
0.01	0.24	1.7	444	...	0.05	0.8	0.10	1
1.45	0.57	10.5	564	100	1.01	4.4	0.11	0
0.05	0.39	1.6	549	63	0.90	14.1	0.13	0
0.50	0.10	21.4	47	2,500-11,000	0.03	0.9	0.10	173

[2] The chemical composition of raw home-pounded rice is given in Table 20.

[3] The chemical composition of white flour, semolina (suji) and breads is given in Tables 18 and 19.

Table 36. Table of

Name of foodstuff	Moisture %	Protein %	Fat %	Mineral matter %	Fibre %	Carbohydrate %
27 Cabbage	90.2	1.8	0.1	0.6	1.0	6.
28 Coriander	87.9	3.3	0.6	1.7	...	6.
29 Drumstick	75.0	6.7	1.7	2.3	0.9	13.
30 Mint	83.0	4.8	0.6	1.6	2.0	8.
31 Ipomoea	90.3	2.9	0.4	2.1	...	4.
32 Radish	87.4	2.2	0.5	2.6	2.2	5.
33 Spinach	91.7	1.9	0.9	1.5	...	4.
Roots and tubers						
34 Carrot	86.0	0.9	0.2	1.1	1.2	10.
35 Colocasia	73.1	3.0	0.1	1.7	...	22.
36 Onion, big	86.8	1.2	0.1	0.4	...	11.
37 Potato	74.7	1.6	0.1	0.6	...	22.
38 Radish	94.4	0.7	0.1	0.6	...	4.
39 Sweet potato	68.5	1.2	0.3	1.0	...	31.
40 Tapioca	59.4	0.7	0.2	1.0	...	38.
41 Yam, elephant	78.7	1.2	0.1	0.8	0.8	18.
Other Vegetables						
42 Brinjal	91.5	1.3	0.3	0.5	...	6.
43 Ash gourd	96.0	0.4	0.1	0.3	...	3.
44 Broad beans	82.4	4.5	0.1	1.0	2.0	10.
45 Cauliflower	89.4	3.5	0.4	1.4	...	5.
46 Cluster beans	82.5	3.7	0.2	1.4	2.3	9.
47 French beans	91.4	1.7	0.1	0.5	1.8	4.
48 Cucumber	96.4	0.4	0.1	0.3	...	2.
49 Ladies finger	88.0	2.2	0.2	0.7	1.2	7.
50 Plantain, green	83.2	1.4	0.2	0.5	...	14.
51 Peas, English	72.1	7.2	0.1	0.8	...	19.
52 Pumpkin	92.6	1.4	0.1	0.6	...	5.
53 Snake gourd	94.1	0.5	0.3	0.7	...	4.
Fruits						
54 Apple	85.9	0.9	0.1	0.3	...	13.
55 Amla (Indian gooseberry) ...	81.2	0.5	0.1	0.7	3.4	14.
56 Banana	61.4	1.3	0.2	0.7	...	36.
57 Guava	76.1	1.5	0.2	0.8	6.9	14.

Food Values

Calcium (Ca) %	Phosphorus (P) %	Iron (Fe) mg. %	Calorific value per 100 g.	Vitamin A value, (I.U. per 100 g.)	Vitamin B_1 (mg. per 100 g.)	Nicotinic acid (mg. per 100 g.)	Riboflavin (mg. per 100 g.)	Vitamin C (mg. per 100 g.)
0·03	0·05	0·8	33	2,000	0·06	0·4	0·12	124
0·14	0·06	10·0	45	10,460-12,600	0·05	0·8	0·13	135
0·44	0·07	7·0	96	11,300	0·06	0·8	0·12	220
0·20	0·08	15·6	57	2,700	0·05	0·4	0·14	85
0·11	0·05	3·9	32	3,300	0·05	0·6	0·12	137
0·12	0·09	4·8	33	6,700	0·05	0·5	0·12	65
0·06	0·04	5·0	32	5,500	0·05	0·5	0·11	48
0·08	0·03	1·5	47	2,000-4,300	0·04	0·4	0·02	3
0·04	0·14	2·1	101	40	0·09	0·4	0·03	...
0·18	0·05	0·7	51	...	0·08	0·4	0·01	11
0·01	0·03	0·7	99	40	0·10	1·2	0·01	17
0·05	0·03	0·4	21	...	0·06	0·4	0·02	15
0·02	0·05	0·8	132	10	0·08	0·7	0·04	24
0·03	0·04	0·9	159	...	0·05	0·3	0·01	...
0·05	0·02	0·6	79	434	0·06	0·7	0·07	...
0·02	0·06	1·3	34	5	0·05	0·8	0·06	23
0·03	0·02	0·5	15	...	0·06	0·4	0·01	5
0·05	0·06	1·6	59	...	0·08	0·8	0·07	12
0·03	0·06	1·3	39	38	0·10	0·9	0·08	66
0·13	0·05	5·8	56	330	0·08	0·5	0·06	49
0·05	0·03	1·7	26	221	0·08	0·3	0·06	14
0·01	0·03	1·5	14	...	0·03	0·2	0·02	7
0·09	0·08	1·5	41	58	0·06	0·6	0·06	16
0·01	0·03	0·6	66	50	0·05	0·3	0·02	24
0·02	0·08	1·5	109	139	0·25	0·8	0·01	9
0·01	0·03	0·7	28	84	0·06	0·5	0·04	2
0·05	0·02	1·3	22	160	0·04	0·3	0·04	...
0·01	0·02	1·7	56	...	0·03	0·2	0·03	2
0·05	0·02	1·2	59	...	0·03	0·2	0·03	700
0·01	0·05	0·4	153	...	0·04	0·3	0·03	1
0·01	0·04	1·0	66	...	0·03	0·2	0·03	300

Table 36. **Table of**

Name of foodstuff	Moisture %	Protein %	Fat %	Mineral matter %	Fibre %	Carbohydrate %
58 Lime	84·6	1·5	1·0	0·7	1·3	10·9
59 Mango, ripe	86·1	0·6	0·1	0·3	1·1	11·8
60 Orange	87·6	0·9	0·3	0·4	...	10·6
61 Papaya, ripe	89·6	0·5	0·1	0·4	...	9·5
62 Pears, country	86·9	0·2	0·1	0·3	1·0	11·5
63 Pineapple	86·5	0·6	0·1	0·5	0·3	12·0
64 Plantain (ordinary) ...	73·4	1·1	0·1	0·7	...	24·7
65 Tomato, ripe	94·5	1·0	0·1	0·5	...	3·9
66 Tamarind, pulp	20·0	3·1	0·1	2·9	5·6	67·4
Milk and Milk Products						
67 Milk, cow's	87·6	3·3	3·6	0·7	...	4·8
68 Milk, buffalo's	81·0	4·3	8·8	0·8	...	5·0
69 Milk, goat's	85·2	3·7	5·6	0·8	...	4·7
70 Milk, human	88·0	1·0	3·9	0·1	...	7·0
71 Curds (from cow's milk) ...	90·3	2·9	2·9	0·6	...	3·3
72 Skimmed milk powder (from cow's milk) ...	4·1	38·0	0·1	6·8	...	51·0
73 Milk condensed, sweetened (from cow's milk) ...	27·0	8·1	8·4	1·6	...	55·0
74 Whole milk powder (from cow's milk)	3·5	25·8	26·7	6·0	...	38·0
Flesh Foods						
75 Egg, duck's	71·0	13·5	13·7	1·0	...	0·7
76 Egg, hen's	73·7	13·3	13·3	1·0	...	...
77 Fish	77·9	21·5	1·6	2·0	...	...
78 Liver, goat	70·4	19·3	7·5	1·5	...	1·4
79 Mutton (goat) ...	71·5	18·5	13·3	1·3	...	...
80 Prawn	77·9	20·8	0·3	1·4	...	...
81 Fowl	72·2	25·9	0·6	1·3	...	...
Miscellaneous Foods						
82 Arrowroot flour	16·5	0·2	0·1	0·1	...	83·1
83 Betel leaves	85·4	3·1	0·8	2·3	2·3	6·1
84 Cocoanut water	95·5	0·1	0·1	0·4	...	4·0
85 Jaggery	3·9	0·4	0·1	0·6	...	95·0
86 Sago	12·2	0·2	0·1	0·3	...	87·2
87 Vermicelli	11·4	10·3	0·7	0·8	0·2	76·6
88 Yeast, dried (food)	7·8	35·7	1·8	8·4	...	46·3

Food Values

Calcium (Ca) %	Phosphorus (P) %	Iron (Fe) mg. %	Calorific value per 100 g.	Vitamin A value, (I.U. per 100 g.)	Vitamin B_1 (mg. per 100 g.)	Nicotinic acid (mg. per 100 g.)	Riboflavin (mg. per 100 g.)	Vitamin C (mg. per 100 g.)
.09	0.02	0.3	59	26 (juice)	0.02	0.1 (juice)	0.02	63 (juice)
.01	0.02	0.3	50	4,800	0.04	0.3	0.05	24
.05	0.02	0.1	49	350	0.05	0.3	0.06	68
.01	0.01	0.4	40	2,020	0.04	0.2	0.05	46
.01	0.01	0.7	47	14	0.02	0.2	0.03	...
.02	0.01	0.9	50	60	0.03	0.2	0.04	63
.01	0.03	0.5	104	124	0.04	0.3	0.05	6
.01	0.02	0.1	21	320	0.04	0.4	0.05	32
.17	0.11	10.9	283	100	0.06	0.7	0.04	3
.12	0.09	0.2	65	180	0.05	0.1	0.20	1.6
.21	0.13	0.2	117	162	0.04	0.1	0.19	1.5
.17	0.12	0.3	84	182	0.04	0.1	0.15	1.5
.12	0.01	0.2	67	208	0.02	0.1	0.05	2.2
.12	0.19	0.3	51	130	0.06	0.1	0.20	1.6
.37	1.00	1.4	357	0	0.45	1.0	1.64	4.8
.28	0.23	0.4	328	430	0.05	0.2	0.41	0
.95	0.73	0.6	496	1,400	0.31	0.8	1.36	4.4
.07	0.26	3.0	180	2,100	0.12	0.2	0.33	...
.06	0.22	2.1	173	2,200	0.13	0.1	0.35	...
.06	0.41	2.3	100	26	0.10	3.0	0.15	...
.01	0.38	6.3	150	22,300	0.36	17.6	3.20	20
.15	0.15	2.5	194	31	0.18	6.8	0.27	...
.09	0.24	0.8	86	Trace	0.09	4.8	0.10	...
.03	0.25	1.5	109	230	0.08	5.6	0.16	...
.01	0.02	1.0	334	0	0	0	0	0
.23	0.04	5.7	44	9600	0.07	0.7	0.03	5
.02	0.01	0.5	17	...	0.02	0.1	0.02	2
.08	0.04	11.4	383	280	0.02	1.0	...	...
.01	0.01	1.3	351	0	0.02	0	0	0
.02	0.10	1.5	354	...	0.11	1.1	0.03	0
.16	2.09	21.5	344	...	3.20	27.0	4.5	0

APPENDIX I

Net food consumption per person in different countries* (Ounces/day)

Country	Period	Cereals	Potatoes and other starchy roots	Sugar	Pulses and nuts	Meat	Eggs	Fish	Fats and oils	Milk
Europe										
France	1956–57	10·0	13·0	2·3	0·6	7·8	1·0	0·6	1·6	15·8
Western Germany ...	56–57	9·0	15·0	2·8	0·4	5·0	1·1	0·7	2·5	16·2
Ireland	54–56	13·0	18·2	4·2	0·2	5·5	1·6	0·4	2·1	19·0
United Kingdom ...	56–57	8·7	9·5	4·9	0·6	6·9	1·3	1·0	2·2	19·5
North America										
U.S.A.	56–57	6·8	4·7	4·1	0·7	9·5	2·1	0·5	2·0	22·5
Canada	56–57	7·2	7·4	4·4	0·6	8·0	1·7	0·6	1·9	23·5
Oceania										
Australia	54–55	9·1	4·7	5·1	0·5	10·8	1·0	0·4	1·7	17·5
New Zealand ...	54–56	8·6	5·1	4·3	0·5	10·5	1·3	0·7	1·9	26·0
Latin America										
Argentina	55	10·2	7·6	3·3	0·6	10·4	0·6	0·2	1·6	14·5
Brazil	51–52	9·1	11·8	3·3	2·5	2·8	0·3	0·2	0·7	2·8
Far East										
Philippines ...	54–55	13·0	5·0	1·7	0·6	1·0	0·3	1·6	0·3	0·7
Japan	55	15·0	6·7	1·2	3·3	0·4	0·3	2·0	0·3	1·0
India	54–55	12·9	1·2	1·4	2·7	0·1	...	0·1	0·4	4·2

* The state of food and Agriculture (1957) F.A.O. Rome.
Year Book of Food and Agriculture (1957). F.A.O. Rome.

APPENDIX II

Calorific value and protein content of Average National Food supplies per person in different countries*

Country	Year	Calories number/ day	Total protein g/day	Animal protein g/day
Europe				
France ...	1954–55	2980	104	55
Germany, Western ...	,,	2990	79	43
Ireland ...	,,	3590	98	51
United Kingdom	,,	3120	93	52
North America				
Canada ...	,,	3160	97	63
United States ...	,,	3150	94	66
Far East				
India ...	,,	1880	51	6
Japan ...	,,	2050	62	14
Oceania				
Australia ...	,,	3160	92	61
New Zealand ...	,,	3330	104	68
Latin America				
Argentina ...	,,	2970	97	59
Brazil ...	,,	2350	58	17

* From F.A.O. Year Book of Agriculture 1957.

APPENDIX III

Weight Conversion Table

1 Maund (railway)	=	40 seers = 82 pounds (lbs)
1 Seer (Railway)	=	2.05 lbs = 930 grams (g)
1 Chattak	=	2.05 ounces (oz) = 58. 1 g.
1 Viss	=	3.1 lbs = 1.4 Kg = 1400 g.
1 Palam	=	35 g.
1 Tola	=	11.6 g.
1 Pound (lb)	=	16 (oz) = 453.6 g.
1 Ounce (oz)	=	28.4 g.
1 Kilogram (kg)	=	2.2 lbs = 35.2 oz. = 1,000 g.
100 g.	=	3.5 oz.
1 g.	=	1,000 milligram (mg)
1 mg.	=	1,000 microgram (μg)

APPENDIX IV

'Adult Consumption Unit' Coefficients

It is usual to assess the food requirements of women and children in terms of those of the average man. For this purpose, the following 'adult consumption unit' or 'adult man-value' coefficients are used.

	'Adult consumption unit' coefficients.
Adult male	... 1.0
Adult female	... 0.9
Adolescent boys & girls (13–21 yrs)	1.0
Children (9–12 yrs)	... 0.8
,, (7–8 yrs)	... 0.7
,, (5–6 yrs)	... 0.6
,, (3–4 yrs)	... 0.5
,, (1–2 yrs)	... 0.4

These coefficients are used for assessing the food requirements of a group of mixed age and sex composition *e.g.* a family or groups of families or the entire population of a country. For example the food requirements of a family consisting of father, mother and 3 children aged 10, 8 and 6 years respectively, in terms of 'adult consumption units', are given below :

	'Adult consumption unit'
Father	... 1.0
Mother	... 0.9
Child (10 yrs)	... 0.8
,, (8 yrs)	... 0.7
,, (6 yrs)	... 0.6
Total	4.0

The above scale is only, at best, an approximation. Physique, physical activity and climate are so variable in different areas that the same scale of food requirements

and coefficients may not be suitable for application throughout the country. A somewhat higher food intake would be appropriate in North India (particularly during the winter months) than in South India. Though the requirements of an average woman are less than that of an average man, the needs of an expectant or a nursing mother may, however, be equal to or greater than those of a man because of the additional food required to nourish the foetus or the child (see Table 24 in the text).

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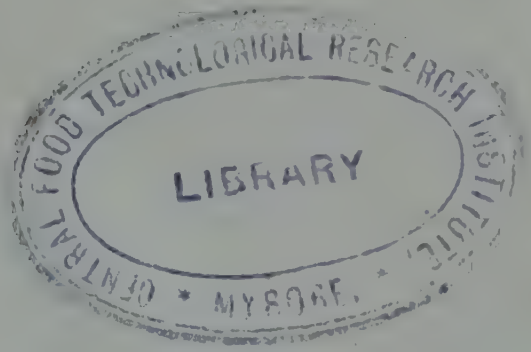

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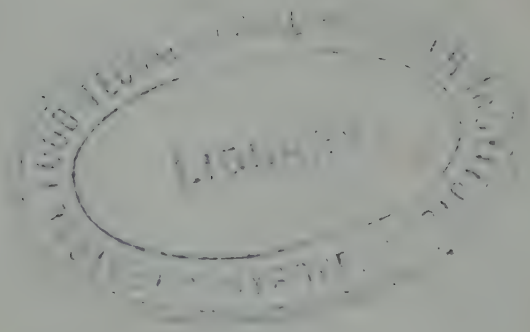

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